Manitoba
Agriculture

Agdex 250-32.

1986 Vegetable Crop Production Guide

86–1049/

Conversion Table For Herbicide Rates Per Acre

To convert herbicide rate per hectare to rate per acre use the conversion table below:

L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre	L/ha or kg/ha	L/acre or kg/acre
0.00	0.00	2.00	0.81	4.00	1.62	6.00	2.43	8.00	3.24	10.00	4.05	12.00	4.86	14.00	5.67	16.00	6.48	18.00	7.28
0.05	0.02	2.05	0.83	4.05	1.64	6.05	2.45	8.05	3.26	10.05	4.07	12.05	4.88	14.05	5.69	16.05	6.50	19.00	7.69
0.10	0.04	2.10	0.85	4.10	1.66	6.10	2.47	8.10	3.28	10.10	4.09	12.10	4.90	14.10	5.71	16.10	6.52	20.00	8.09
0.15	0.06	2.15	0.87	4.15	1.68	6.15	2.49	8.15	3.30	10.15	4.11	12.15	4.92	14.15	5.73	16.15	6.54	21.00	8.50
0.20	0.08	2.20	0.89	4.20	1.70	6.20	2.51	8.20	3.32	10.20	4.13	12.20	4.94	14.20	5.75	16.20	6.56	22.00	8.90
0.25	0.10	2.25	0.91	4.25	1.72	6.25	2.53	8.25	3.34	10.25	4.15	12.25	4.96	14.25	5.77	16.25	6.58	23.00	9.30
0.30	0.12	2.30	0.93	4.30	1.74	6.30	2.55	8.30	3.36	10.30	4.17	12.30	4.98	14.30	5.79	16.30	6.60	24.00	9.71
0.35	0.14	2.35	0.95	4.35	1.76	6.35	2.57	8.35	3.38	10.35	4.19	12.35	5.00	14.35	5.81	16.35	6.62	25.00	10.12
0.40	0.16	2.40	0.97	4.40	1.78	6.40	2.59	8.40	3.40	10.40	4.21	12.40	5.02	14.40	5.83	16.40	6.64	26.00	10.52
0.45	0.18	2.45	0.99	4.45	1.80	6.45	2.61	8.45	3.42	10.45	4.23	12.45	5.04	14.45	5.85	16.45	6.66	27.00	10.93
0.50	0.20	2.50	1.01	4.50	1.82	6.50	2.63	8.50	3.44	10.50	4.25	12.50	5.06	14.50	5.87	16.50	6.68	28.00	11.33
0.55	0.22	2.55	1.03	4.55	1.84	6.55	2.65	8.55	3.46	10.55	4.27	12.55	5.08	14.55	5.89	16.55	6.70	29.00	11.74
0.60	0.24	2.60	1.05	4.60	1.86	6.60	2.67	8.60	3.48	10.60	4.29	12.60	5.10	14.60	5.91	16.60	6.72	30.00	12.14
0.65	0.26	2.65	1.07	4.65	1.88	6.65	2.69	8.65	3.50	10.65	4.31	12.65	5.12	14.65	5.93	16.65	6.74	31.00	12.55
0.70	0.28	2.70	1.09	4.70	1.90	6.70	2.71	8.70	3.52	10.70	4.33	12.70	5.14	14.70	5.95	16.70	6.76	32.00	12.95
0.75	0.30	2.75	1.11	4.75	1.92	6.75	2.73	8.75	3.54	10.75	4.35	12.75	5.16	14.75	5.97	16.75	6.78	33.00	13.36
0.80	0.32	2.80	1.13	4.80	1.94	6.80	2.75	8.80	3.56	10.80	4.37	12.80	5.18	14.80	5.99	16.80	6.80	34.00	13.75
0.85	0.34	2.85	1.15	4.85	1.96	6.85	2.77	8.85	3.58	10.85	4.39	12.85	5.20	14.85	6.01	16.85	6.82	35.00	14.16
0.90	0.36	2.90	1.17	4.90	1.98	6.90	2.79	8.90	3.60	10.90	4.41	12.90	5.22	14.90	6.03	16.90	6.84	36.00	14.57
0.95	0.38	2.95	1.19	4.95	2.00	6.95	2.81	8.95	3.62	10.95	4.43	12.95	5.24	14.95	6.05	16.95	6.86	37.00	14.97
1.00	0.40	3.00	1.21	5.00	2.02	7.00	2.83	9.00	3.64	11.00	4.45	13.00	5.26	15.00	6.07	17.00	6.88	38.00	15.38
1.05	0.42	3.05	1.23	5.05	2.04	7.05	2.85	9.05	3.66	11.05	4.47	13.05	5.28	15.05	6.09	17.05	6.90	39.00	15.78
1.10	0.45	3.10	1.25	5.10	2.06	7.10	2.87	9.10	3.68	11.10	4.49	13.10	5.30	15.10	6.11	17.10	6.92	40.00	16.19
1.15	0.47	3.15	1.27	5.15	2.08	7.15	2.89	9.15	3.70	11.15	4.51	13.15	5.32	15.15	6.13	17.15	6.94	41.00	16.59
1.20	0.49	3.20	1.30	5.20	2.10	7.20	2.91	9.20	3.72	11.20	4.53	13.20	5.34	15.20	6.15	17.20	6.96	42.00	17.00
1.25	0.51	3.25	1.32	5.25	2.12	7.25	2.93	9.25	3.74	11.25	4.55	13.25	5.36	15.25	6.17	17.25	6.98	43.00	17.40
1.30	0.53	3.30	1.34	5.30	2.14	7.30	2.95	9.30	3.76	11.30	4.57	13.30	5.38	15.30	6.19	17.30	7.00	44.00	17.81
1.35	0.55	3.35	1.36	5.35	2.17	7.35	2.97	9.35	3.78	11.35	4.59	13.35	5.40	15.35	6.21	17.35	7.02	45.00	18.21
1.40	0.57	3.40	1.38	5.40	2.19	7.40	2.99	9.40	3.80	11.40	4.61	13.40	5.42	15.40	6.23	17.40	7.04	46.00	18.62
1.45	0.59	3.45	1.40	5.45	2.21	7.45	3.02	9.45	3.82	11.45	4.63	13.45	5.44	15.45	6.25	17.45	7.06	47.00	19.02
1.50	0.61	3.50	1.42	5.50	2.23	7.50	3.04	9.50	3.84	11.50	4.65	13.50	5.46	15.50	6.27	17.50	7.08	48.00	19.43
1.55	0.63	3.55	1.44	5.55	2.25	7.55	3.06	9.55	3.86	11.55	4.67	13.55	5.48	15.55	6.29	17.55	7.10	49.00	19.83
1.60	0.65	3.60	1.46	5.60	2.27	7.60	3.08	9.60	3.89	11.60	4.69	13.60	5.50	15.60	6.31	17.60	7.12	50.00	20.24
1.65	0.67	3.65	1.48	5.65	2.29	7.65	3.10	9.65	3.91	11.65	4.71	13.65	5.52	15.65	6.33	17.65	7.14	60.00	24.28
1.70	0.69	3.70	1.50	5.70	2.31	7.70	3.12	9.70	3.93	11.70	4.74	13.70	5.54	15.70	6.35	17.70	7.16	70.00	28.33
1.75	0.71	3.75	1.52	5.75	2.33	7.75	3.14	9.75	3.95	11.75	4.76	13.75	5.56	15.75	6.37	17.75	7.18	80.00	32.38
1.80	0.73	3.80	1.54	5.80	2.35	7.80	3.16	9.80	3.97	11.80	4.78	13.80	5.58	15.80	6.39	17.80	7.20	90.00	36.42
1.85	0.75	3.85	1.56	5.85	2.37	7.85	3.18	9.85	3.99	11.85	4.80	13.85	5.61	15.85	6.41	17.85	7.22	100.00	40.47
1.90	0.77	3.90	1.58	5.90	2.39	7.90	3.20	9.90	4.01	11.90	4.82	13.90	5.63	15.90	6.43	17.90	7.24	110.00	44.52
1.95	0.79	3.95	1.60	5.95	2.41	7.95	3.22	9.95	4.03	11.95	4.84	13.95	5.65	15.95	6.45	17.95	7.26	120.00	48.56

Note: L/ha x 0.4047 = L/acre
kg/ha x 0.4047 = kg/acre

Example: 4.5 L/ha x 0.4047 = 1.82 L/acre

1986 Vegetable Crop Production Guide

The 1986 Vegetable Crop Production Guide provides the most up to date information on varieties, cultural techniques, harvest and storage and pest control measures for Manitoba production. The information is based on research and field experience.

This publication is prepared annually by Manitoba Agriculture in cooperation with the Plant Science Department, University of Manitoba.

Note: Recommended rates of pesticides; herbicides, insecticides and fungicides are given in both Metric (L or kg/ha) and Imperial (lb or gal/ac) units. Product labels provide rates only in metric units (L or kg per hectare). To avoid application errors be sure to read and understand label recommendations. Be sure that the **concentration** of product you are using matches the **concentration** shown in the Guide.

If you wish to change the metric units from L or kg per **Hectare** to L or kg per **Acre** multiply the rate in L or kg/ha given on the product label by 0.4 to obtain the rate in L or kg/acre or refer to the conversion chart inside the front cover of this guide.

If you are unsure about the correct amount of product to use don't take a chance. Contact the Provincial Vegetable Crop Specialist at 857-9711, Provincial Potato Crop Specialist at 945-3829 or the chemical company representative for clarification.

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Pesticides

Provincial Poison Control Centre

Health Sciences Centre
Children's Centre
685 Bannatyne Avenue
Winnipeg, Manitoba Telephone 1-787-2591
R3E 0W1

Emergency Procedure For Pesticide Poisoning

If a person suspects poisoning from exposure to a pesticide by swallowing, inhalation, or contact with skin or eyes, read the label on the pesticide container and carry out the first-aid treatment suggested.

If a pesticide has come in contact with the skin or has been spilled on clothing, remove the clothing and wash the skin thoroughly with soap and warm water.

If a pesticide has come in contact with the eyes, rinse them with plenty of water for 15 minutes.

IMMEDIATELY AFTER THE FIRST-AID TREATMENT HAS BEEN GIVEN, WRAP THE PATIENT IN A COAT OR BLANKET AND RUSH HIM TO THE NEAREST HOSPITAL, TAKING THE LABELLED PESTICIDE CONTAINER WITH YOU.

Pesticide Spills

If a pesticide spill is considered major, call:

Environmental Management Branch
Building 2, 139 Tuxedo Ave.
Winnipeg, Manitoba R3N 0H6

Telephone: 944-4888 (24 hours)

Important Pesticide Notes

Pesticides include all materials used to control weed, insect, and disease pests interfering with crop production.

All pesticides recommended in this publication are toxic. A list of all pesticides recommended in this guide and their relative mammalian toxicity is found on pages 6 to 8.

The product rates recommended are based on the actual amount of product required to treat a hectare unless otherwise stated. All rates are given in metric and imperial measure, except for the Weed Control sections, which are in metric only.

Always read the product label prior to product use to insure recommendations regarding crop, rates, timing of application, required water volumes, possible plant injury, compatibility with other materials, effect of weather conditions, toxicity, handling requirements, etc.

The pesticides recommended herein are for commercial plantings only. Home gardeners should consult their agricultural representative for recommendations regarding garden pest control.

A number of brand or trade names of chemicals are used for the convenience of readers. This constitutes neither an endorsement of the product nor a suggestion that similiar products are not effective.

For additional information consult your local Agricultural Representative or Provincial Vegetable Crop Specialist at 857-9711 ext. 275.

Precautions With Pesticides

Rules Everyone Must Know Before Using Any Pesticides

1. Always read the label before opening pesticide containers. Follow all precautions and directions precisely.
2. Never smoke, chew tobacco, or eat while handling or applying pesticides. Do not carry these items in clothes used for spraying.
3. Avoid spilling pesticides on skin or clothing. If an accident occurs, remove contaminated clothing immediately, and wash contaminated skin thoroughly with soap and water. Wash clothing before wearing.
4. Wash thoroughly with soap and water after applying or handling pesticides.
5. If clothing becomes wet with a pesticide, remove it immediately. Always wash clothing after each spray operation.
6. Avoid inhaling spray droplets, dust or fumes.
7. Clean-up pesticide spills immediately. Use dry soil or other absorbent material to remove excess liquid. If a spill is major, call: Environmental Management Branch, Building 2, 139 Tuxedo Ave., Winnipeg, Manitoba R3N 0H6. Phone 944-4888 (24 hours)
8. If symptoms of illness occur during or shortly after handling or applying pesticides, get to a hospital immediately. If possible, take a labeled container of the pesticide with you.
9. Avoid contamination of water supplies, wells, ponds, streams, etc., with pesticides when filling or flushing out spray equipment. Never fill a sprayer directly from a stream or pond, unless the unit is equippped with an anti-siphoning device to prevent backflow. Use an injection or siphon filler to fill an overhead tank and fill the sprayer from it.

Disposal of Pesticide Containers and Contaminated Material

1. Containers from pesticide packages and any paper or other material used to clean up spills should be buried.
2. Rinse all empty metal or glass containers three times with water, add washings to the spray tank. Dispose of the containers by puncturing or breaking or burying the container in such a manner that it is covered by at least 50 cm of soil and is not near any watercourse or water table. Contact your local Agricultural Representative or Weed Supervisor for the location of the Pesticide Container Disposal Area nearest to you.

Pesticide Drift

Pesticide drift can; 1. leave unwanted residues on adjacent crops; 2. be a hazard to people and livestock nearby; 3. reduce the amount of material in the target area so that it is ineffective.

Those applying pesticides should make every effort to minimize or prevent pesticide spray drift by:

1. correct calibration and maintenance of spray equipment;
2. correct operation of the equipment;
3. being aware of the toxicity of the pesticide being used;
4. being aware of the weather conditions.

Custom Application — Ground and Air

Custom applicators must be licensed by Manitoba Agriculture.

It is an offense under the Federal Pest Control Products act to use a control product under unsafe conditions. Precautionary practices must be heeded at all times to prevent drift. Extra precautions should be taken when using insecticides applied by air, especially those known to be toxic to honeybees, e.g. Sevin (carbaryl).

Applications should not be made if the wind is blowing 20 km/h (12 mph) or more or is blowing towards a sensitive crop.

Be sure that the contract specifies the product to be used and its rate of application.

Protective Clothing and Equipment

1. When measuring and mixing pesticides, wear neoprene or rubber gloves, rubber boots, a protective apron or coveralls, and protective eye shields. (Inexpensive disposable aprons, shirts, pants, and headwear are also now available.)
2. Wash all protective clothing after use.
3. Wear a chemical cartridge respirator with dual chemical cartridge when mixing or applying pesticide. The following respirators are recommended for outside use against light pesticide concentrations:

   WILLSON AGRI-TOX 2 Respirator with R21 cartridges and R15 filters;

   NORTON 7549 or 7649 Respirator with 7500-21 cartridges and 7500-23 filters;

   MSA 448848 or 460560 Respirator with 464025 combination cartridges;

   AMERICAN OPTICAL R4058, R5058 or R6058 Respirator with R50 filter/cartridges;

   PULMOSAL 241 Respirator with 241-7 filter/cartridges;

   SAFETY HOUSE OF CANADA 236-G100-F104 Respirator with G100 cartridges and F104 filters;

   H.S. COVER 1482 Respirator with 100 cartridges and 104 filters.

Respirators should always be worn when applying pesticides listed in the "highly toxic" categories in this publication. Change cartridges according to manufacturer's directions.

A powered chemical cartridge respirator, W-262 GENERAL-PURPOSE SYSTEM, is now available from the 3M Company, and is suitable for vehicle mounting.

Disposable Plastic and Waterproof Clothing

There are now available plastic aprons, disposable hoods, laboratory coats, boot covers, coveralls, protective female smocks, and hat covers at a reasonable price. A special two-piece coverall set for easy movement and comfort is also available.

Any of the above are available direct from TITAN Disposables Limited, 8530 Esplanade Ave., Montreal, P.Q. H2P 2R8. Telephone (514) 381-2301. Telephone or write for prices and further information.

Protective clothing is also available from many of the safety-supply companies.

Reentry to Treated Areas

Pesticide poisoning may occur where workers enter fields too soon after pesticides have been applied. Such poisoning can result from handling treated plants or from inhalation of pesticide fumes.

The following pesticides are those for which a specific minimum interval must be observed from the time of application to the time of working in the crop. For some pesticides, e.g. parathion, the label carries a warning regarding working in treated crops. **Follow these recommendations.** Where no label warnings are provided, the following minimum intervals are recommended.

24 hours	***48 hours***
Lannate	Birlane
Supracide	Dasanit
	Furadan
	Guthion
	Meta-Systox R
	Monitor
	Phosvel
	Systox
	Temik

Pesticides for Protecting Vegetable Crops

Only compounds recommended in this guide are listed. No endorsement of named products is intended, nor is criticism implied of similar products not included.

Pesticides listed are recommended on the basis of safety, effectiveness, availability and cost. Those not listed may be used in Manitoba if they are registered under the Canada Pest Control Products Act, and have a permit as outlined under the Clean Environment Act.

Rates of application for insecticides, herbicides and fungicides are stated as actual amounts of product required per hectare (acre), unless otherwise stated.

Fungicides

anilazine ..... Dyrene
Arasan ..... thiram, Thiram
Basi-cop ..... fixed copper, Tri-cop, Neutro-cop, Kocide 101
Benlate ..... benomyl, Tersan 1991
Benomyl ..... Benlate, Tersan 1991
benomyl ..... Benomyl, Benlate, Tersan 1991
Bravo ..... chlorothalonil
captafol ..... Difolatan
Captan ..... captan, Orthocide
captan ..... Captan, Orthocide
carbathiin-thiram ..... Pro-Gro, Vitaflo 280
chlorothalonil ..... Bravo
copper sulphate (bluestone) ..... copper sulphate (bluestone)
Dexon ..... Lesan, fenaminosulf
Difolatan ..... captafol
Dithane M-22 ..... maneb, Manzate D
Dithane M-45 ..... mancozeb, Manzate 200
Dithane Z-78 ..... zineb
Dyrene ..... anilazine
Easout ..... thiophanate-methyl
fenaminosulf ..... Dexon, Lesan
fixed copper ..... Basi-cop, Tri-cop, Neutro-cop, Kocide 101
Iprodione ..... Rovral
Kocide 101 ..... fixed copper, Basi-cop, Tri-cop, Neutro-cop
Lesan ..... Dexon, fenaminosulf
mancozeb ..... Dithane M-45, Manzate 200
maneb ..... Dithane M-22, Manzate D
Manzate D ..... maneb, Dithane M-22
Manzate 200 ..... mancozeb, Dithane M-45
Mertect ..... thiobendazole
metiram ..... Polyram
Neutro-cop ..... fixed copper, Basi-cop, Tri-cop, Kocide 101
Orthocide ..... Captan
Polyram ..... metiram
Pro-Gro, Vitaflow 280 ..... carbathiin-thiram
Rovral ..... Iprodione
Tersan 1991 ..... benomyl, Benlate
thiobendazole ..... Mertect
thiophanate-methyl ..... Easout
Thiram ..... thiram, Arasan
thiram ..... Thiram, Arasan
Tri-cop ..... fixed copper, Basi-cop, Neutro-cop, Kocide
Pro-Gro, Vitaflo 280 ..... carbathiin-thiram
zineb ..... Dithane Z-78

Herbicides

Aatrex ..... atrazine, Atrazine
Afolan ..... linuron, Lorox L
Agricultural Weed Killer No. 1 ..... stoddard solvent
Alanap 3 ..... naptalam
Amitrol ..... Amitrol T, Cytrol
Amitrol T ..... Amitrol, Cytrol
Atrazine ..... atrazine, Aatrex
atrazine ..... Aatrex, Atrazine
Bar-Fox ..... Trichloroacetic acid
Basfapon ..... dalapon, Dowpon
Basagran ..... bentazon
bensulide ..... Prefar
bentazon ..... Basagran
bromoxynil octanoate ..... Torch DS, Pardner
bromoxynil octanoate + MCPA ester ..... Buctril M
Buctril M ..... bromoxynil octanoate + MCPA ester
butylate ..... Sutan
cycloate ..... Ro-Neet
Cytrol ..... Amitrol, Amitrol T
dalapon ..... Basfapon, Dowpon
2, 4-D Amine ..... 2, 4-dichlorophenoxyacetic acid
dicamba + 2, 4-D + mecoprop ..... Kil-mor
dinoseb ..... Sinox PE
2, 4-dichlorophenoxyacetic acid ..... 2, 4-D Amine
diclofop methyl ..... Hoe-Grass 284
Dowpon ..... dalapon, Basfapon
Dual-Ciba Geigy ..... Metalochlor
Dyanap ..... Naptalam + Dinoseb
Eptam ..... EPTC
EPTC ..... Eptam
EPTC + R25788 ..... Eradicane 8-E
Eradicane 8-E ..... EPTC + R25788
fluazifop butyl ..... Fusilade
Fusilade ..... Fluazifop butyl
Glyphosate ..... Round-up
Goal ..... oxyfluorfen
Gramoxone ..... paraquat
Hoe Grass 284 ..... Diclofop methyl
ioxynil ..... Totril
Kil-mor ..... dicamba + 2, 4-D + mecoprop
Lasso ..... Alachlor
Lexone ..... metribuzin, Sencor
linuron ..... Afolan, Lorox L
Lorox L ..... linuron, Afolan
Metalochlor ..... Dual-Ciba-Geigy
Metalochlor + atrazine ..... Primextra
metribuzin ..... Lexone, Sencor
Naptalam ..... Alanap 3
Naptalamt + Dinoseb ..... Dynap
oxyflourfen ..... Goal
paraquat ..... Gramoxone
Pardner ..... bromoxynil octanoate, Torch
Prefar ..... bensulide
Primextra ..... metalachlor + atrazine
Princep-Nine-T ..... simazine, Simadex 80W, Simadex
RIVAL ..... trifluralin
Ro-Neet ..... cycloate
Roundup ..... Glyphosate
Sencor ..... metribuzen, Lexone
simazine ..... Simadex, Simadex 80W, Princep-Nine-T
Simazine 80W ..... simazine, Simadex, Princep-Nine-T
Sinox PE ..... dinoseb
Sodium TCA ..... Trichloroacetic acid, Bar-Fox
stoddard solvent ..... Agricultural Weed Killer No. 1
Sutan ..... butylate
Torch ..... bromoxynil octanoate, Pardner
Torch DS ..... bromoxynil octanoic + butyric
Totril ..... ioxynil

Treflan.....trifluralin
trichloroacetic acid.....Bar-fox, Sodium TCA
trifluralin.....Rival, Treflan, Triflurex
Triflurex.....Rival, Treflan, trifluralin
Sinox PE.....dinoseb

Insecticides

Ambush.....permethrin
azinphos-methyl.....Guthion
Bacillus thuringiensis.....Thuricide, Dipel
Belmark.....fenvalerate
Birlane.....chlorfenvinfos
carbofuran.....Furadan
carbaryl.....Sevin
chlorfenvinfos.....Birlane
chlorpyrifos.....Lorsban
Cygon.....dimethoate
Dasanit.....fensulfothion
Decis.....deltamethrin
deltamethrin.....Decis
Diazinon.....diazinon
diazinon.....Diazinon
dimethoate.....Cygon
Dipel.....Bacillus thuringiensis, Thuricide
Dyfonate.....fonofos
endosulfan.....Thiodan
fensulfothion.....Dasanit
fenvalerate.....Belmark
fonofos.....Dyfonate
Furadan.....carbofuran
Guthion.....azinphos-methyl
Lannate.....methomyl
lindane.....lindane
Lorsban.....chlorpyrifos
Malathion.....malathion
malathion.....Malathion
metaldehyde.....metaldehyde
methamidophos.....Monitor
methidathion.....Supracide
methomyl.....Lannate
Monitor.....methamidophos
permethrin.....Ambush
phorate.....Thimet
Rotenone.....rotenone
Sevin.....carbaryl
Supracide.....methidathion
Thimet.....phorate
Thiodan.....endosulfan
Thuricide.....Bacillus thuringiensis, Dipel

Molluscicides

metaldehyde.....Slug Bait

Sprout Inhibitors

maleic hydrazide.....Royal MH 60SG

Top-Killers

diquat.....Reglone
Reglone.....diquat

Relative Mammalian Toxicity of Pesticides

To simplify information, brand or trade names of products have been used. No endorsement is intended, nor is criticism implied of similar products not mentioned. Only products recommended in this guide are listed.

Rubber gloves should be worn when handling and mixing any pesticide in concentrate form. Protective equipment such as an approved agricultural respirator and rubber gloves should be worn when handling, mixing or applying a pesticide marked with an *.

Very Toxic

Oral (by mouth) LD 50, 0-50
A.W.K. #1 (stoddard solvent, mineral oil)*
Birlane (chlorfenvinphos)*
Dasanit (fensulfothion)*
Furadan (carbofuran)*
Gramoxone (paraquat)*
Guthion (azinphos-methyl)*
Lannate (methomyl)*
Monitor (methamidophos)*
Sinox P.E. (dinoseb amine)*
Supracide (methidathion)*
Thimet (phorate)*

Dermal (skin absorption) LD 50, 0-200
Birlane (chlorfenvinphos)*
Dasanit (fensulfothion)*
Dexon (fenaminosulf)*
Lesan (fenaminosulf)*
Monitor (methamidophos)*
Sinox P.E. (dinoseb amine)*
Thimet (phorate)*
Totril (ioxynil)*

Moderately Toxic

Oral (by mouth) LD 50, 50-500
Banvel 3, Kil-mor (dicamba + 2, 4-D + mecoprop)
Basagran (bentazon)
Belmark (fenvalerate)
Buctril M (bromoxynil + MCPA)
copper, fixed
copper sulphate (bluestone)
Cygon (dimethoate)
2, 4-D
Decis (deltamethrin) — eye irritant
Dexon (fenaminosulf)
diazinon
Dyfonate (fonofos)
Kil-mor, Banvel 3 (dicamba + 2, 4-D + mecoprop)
Lesan (fenaminosulf)
lindane*
Lorsban (chlorpyrifos)*
Mertect (thiobendazole)
Neutro-cop (fixed copper)
Pardner, Torch DS (bromoxynil)
Reglone (diquat)

rotenone
Sevin (carbaryl)
Thiodan (endosulfan)*
Torch DS (bromoxynil)
Totril (ioxynil)*

Dermal (skin absorption) LD 50, 200-1000

Cygon (dimethoate)
diazinon
Furadan (carbofuran)*
Gramoxone (paraquat)*
Guthion (azinphos-methyl)*
lindane*
Lorsban (chlorpyrifos)*
Mertec (thiobendazole)
Reglone (diquat)
Thiodan (endosulfan)*

Slightly Toxic

Oral (by mouth) LD 50, 500+

Aatrex (atrazine)
Afolan, Lorox (linuron)
Alanap 3 (naptalam)
Ambush (permethrin)
Amitrol T, Cytrol, amitrol
Arasan (thiram)
Bacillus thuringiensis (Dipel, Thuricide)
Basfapon (dalapon)
Benlate (benomyl)
Bravo (chlorothalonil)
Captan (captan)
CIPC (chloropropham)
Cytrol, Amitrol T, amitrol
Difolatan (captafol)
Dipel (Bacillus thuringiensis, Thuricide)
Dithane M-22, Dithane M-45 (maneb, mancozeb)
Dithane Z-78 (zineb)
Dowpon (dalapon)
Dyanap (naptalam + dinoseb)
Dyrene (anilazine)
Easout (thiophanate-methyl)
Eptam (EPTC)
Eradicane (EPTC + R25788)
Hoe Grass
Lexone (metribuzin)
Lorox, Afolan (linuron)
Malathion
Manzate D (maneb)
Manzate 200 (mancozeb)
Mertect (thiobendazole)
metaldehyde
Royal MH50SG (maleic hydrazide)
Orthocide (captan)
Polyram (metiram)
Prefar (bensulide)
Primextra (metalochlor + atrazine)
Princep, Simazine 80W (simazine)
Pro-Gro (carbathiin + thiram)
RIVAL (trifluralin)
Ro-Neet (cycloate)
Roundup (glyphosate)
Rovral (Iprodione)
Sencor (metribuzen)
Simadex (simazine)
Sutan (butylate)
TCA (sodium trichloroacetic acid)
Tersan 1991 (benomyl)
thiram
Thuricide (Bacillus thuringiensis)
Treflan (trifluralin)
Triflurex (trifluralin)
Vitaflo 280 (carbathiin + thiram)
zineb

Dermal (skin absorption) LD 50, 1000+

Aatrex (atrazine)
Afolan, Lorox (linuron)
Alanap 3 (naptalam)
Ambush (permethrin)
Amitrol T, Cytrol (amitrol)
Arasan (thiram)
A.W.K. #1 (stoddard solvent, mineral oil)*
Bacillus thuringiensis (Dipel, Thuricide)
Banvel 3, Kil-mor (dicamba + 2, 4-D + mecoprop)
Basagran (bentazon)
Basfapon (dalapon)
Belmark (fenvalerate)
Benlate (benomyl)
Bravo (chlorothalonil)
Buctril M (bromoxynil + MCPA)
Captan (captan)
CIPC (chloropropham)
copper, fixed
copper sulphate (bluestone)
Cytrol, Amitrol T (amitrol)
2, 4-D
Decis (deltamethrin) — eye irritant
Difolatan (captafol)
Dipel (Bacillus thuringiensis)
Dithane M-22, Dithane M-45 (maneb, mancozeb)
Dithane Z-78 (zineb)
Dowpon (dalapon)
Dyanap (naptalam + dinoseb)
Dyfonate (fonofos)
Dyrene (anilazine)
Easout (thiophanate-methyl)
Eptam (EPTC)
Eradicane (EPTC + R25788)
Hoe Grass 284 (diclofop methyl)
Kil-mor, Banvel 3 (dicamba +2, 4-D + mecoprop)
Lannate (methomyl)*
Lexon (metribuzin)
Lorox, Afolan, (linuron)
Lorsban (chlorpyrifos)
Malathion
Maloran (chlorbromuron)
Manzate D (maneb)
Manzate 200 (mancozeb)
Mertect (thiobendazole)
metaldehyde
Royal MH60SG (maleic hydrazide)
Neutro-Cop (fixed copper)
Orthocide (captan)
Pardner, Torch DS (bromoxynil)
Polyram (metiram)
Prefar (bensulide)

Primextra (metalachlor + atrazine)
Princep, Simazine 80W (simazine)
Pro-Gro (carbathiin-thiram)
Ro-Neet (cycloate)
rotenone
RIVAL (trifluralin)
Roundup (glyphosate)
Rovral (Iprodione)
Sencor (metribuzin)
Sevin (carbaryl)
TCA (sodium trichloroacetic acid) Bar-fox
Supracide (methidathion)*
Sutan (butylate)
Tersan (benomyl)
thiram
Thuricide (Bacillus thuringiensis)
Torch DS, Pardner (bromoxynil)
Torch DS (bromoxynil)
Treflan (trifluralin)
Tri-Cop (fixed copper)
Triflurex (trifluralin)
Vitaflow 280 (carbathiin-thiram)
zineb

Storage of Pesticides

1. Keep pesticides out of reach of children, inexperienced persons, pets and livestock. Store them in a locked room away from your home. Post pesticide storage-area notices.
2. Always store pesticides in original containers and keep them tightly closed. Never put pesticides in unmarked containers.

I. Herbicides

A. Herbicides which must be kept in heated storage (DO NOT FREEZE)

Agriculture Weedkiller No. 1
Afolan F
Amitrol-T
Alanap 3
Basagran
Chloro-IPC (CIPC)
Dyanap
Dyvel
Goal
Gramoxone
Hoe Grass 284
Kil-Mor
Lasso
Lorox L
Pardner
Potato Top Killer 300
Prefar
Premerge 360
Randox
Reglone
RIVAL
Ro-Neet 7.2E
Simadex
Sinox PE
TCA Solution
Totril
2,4-D Amine

B. Herbicides which may be stored at freezing temperatures. These must be returned to their original state by warming to room temperature 20 to 22°C, and agitating thoroughly before use.

AAtrex Liquid
AAtrex Plus
Atrazine Liquid
Buctril M (560g/L)
Dual-Ciba-Geigy
Eptam 8-E
Eradicane 8-E
Lexone L
Primextra
Roundup
Sencor 500
Sutan +
Torch DS
Treflan EC
Triflurex

C. Herbicides normally sold as granules or powders: (These are not usually damaged by freezing). Store in dry place.

AAtrex WP
AAtrex Nine-O
Atrazine 80W
Bar-fox
Basfapon
Bluestone
Dalapon
Dowpon
Dowpon M
Eptam 10G
Lexone DF
Nata TCA
Princep-Nine-T
Sencor 75 DF
Simadex 80W
TCA
Treflan QR5

II. Fungicides

Store liquids in a dry location with a temperature of 3-4°C. Store granules, powders, etc. in a dry location. Freezing temperatures are not detrimental to granular or powder formulations.

III. Insecticides

Store liquids in a dry location with a temperature of 3-4°C. Store granules, powders, etc. in a dry location. Freezing temperatures are not detrimental to granular or powder formulations.

Residue Tolerances and Days to Harvest

Tolerances for residues of agricultural chemicals on vegetables when offered for sale have been set by the Department of National Health and Welfare, Ottawa.

To avoid exceeding the residue tolerance for insecticides, herbicides and fungicides:

- DO NOT APPLY THEM LATER THAN RECOMMENDED.
- DO NOT APPLY THEM MORE OFTEN THAN RECOMMENDED ON THE LABEL.
- DO NOT APPLY MORE THAN THE RECOMMENDED AMOUNT.

Pre-Harvest Wait Periods for Fungicides

Basi-Cop Tri-Cop Neutro-Cop Kocide 101	(fixed coppers)	Snap Beans	1 day
		Cucumbers	1 day
		Pumpkins	1 day
		Squash	1 day
		Tomatoes	1 day
Benlate Tersan 1991	(benomyl)	Snap Beans	14 days
		Carrots	0 days
		Cucumbers	0 days
		Pumpkins	0 days
		Squash	0 days
Bravo (chlorothalonil)		Cabbage	7 days
		Brussel Sprouts	7 days
		Broccoli	7 days
		Cauliflower	7 days
		Carrots	1 day
		Celery	7 days
		Cucumbers	1 day
		Pumpkins	1 day
		Squash	1 day
		Potatoes	1 day
		Tomatoes	1 day
Difolatan (captafol)		Potatoes	1 day
		Tomatoes	1 day
		Onions	1 day
Dithane M-22 (maneb)		Carrots	5 days
		Celery	7 days
		Onions	10 days
		Potatoes	10 days
		Tomatoes	1 day
Manzate D		Potatoes	1 day
		Tomatoes	3 days
		Onions	10 days
Dithane M-45 Manzate 200	(mancozeb)	Carrots	7 days
		Potatoes	1 day
		Tomatoes	1 day
		Onions	10 days
Dithane Z-78 (zineb)		Asparagus	Do not apply to spears
		Carrots	7 days
		Tomatoes	5 days
Dyrene (anilazine)		Celery	7 days
		Onions	7 days
Polyram (metiram)		Carrots	5 days
		Potatoes	1 day
		Tomatoes	1 day
Rovral (Iprodione)		Snap beans	15 days
		Onions	15 days

For additional information refer to Table 3.

Pre-Harvest Wait Periods for Insecticides

Ambush (permethrin)	Cabbage, Cauliflower	3 days
	Brussel Sprouts	3 days
	Broccoli	7 days
	Peppers	1 day
	Potatoes	1 day
	Sweet Corn	1 day
Belmark (fenvalerate)	Cabbage, Cauliflower,	14 days
	Brussel Sprouts	14 days
	Potatoes	7 days
Cygon, (dimethoate)	Red Beets (for greens)	12 days
	Cabbage, Cauliflower,	4 days
	Broccoli	4 days
	Brussel Sprouts	21 days
	Peppers	3 days
	Potatoes	7 days
Diazinon (diazinon)	Red Beets	14 days
	Broccoli, Cauliflower	5 days
	Brussel Sprouts	14 days
	Cabbage	7 days
	Onions	10 days
	Radish	10 days
	Rutabaga	14 days
Dasinit (fensulfothion)	Onions	45 days
	Rutabaga	40 days
Decis (deltamethrin)	Broccoli	7 days
	Cabbage	7 days
	Brussel Sprouts	7 days
	Cauliflower	7 days
	Potatoes	23 days
Furadan (carbofuran)	Potatoes	7 days
	Rutabaga	40 days
Guthion (azinphos methyl)	Potatoes	7 days
Lannate (methomyl)	Cauliflower	7 days
	Broccoli	7 days
	Brussel Sprouts	7 days
	Cabbage	1 day
	Sweet Corn	3 days
Lorsban 4E (chlorpyrifos)	Broccoli	32 days
	Brussel Sprouts	32 days
	Cabbage	32 days
	Green Peppers	40 days
	Carrots	60 days
	Cauliflower	32 days
	Bulb Onions	60 days
	Tomato	70 days
	Potato	7 days
	Celery	70 days
	Rutabagas	30 days
	Cucumbers	60 days
Lorsban 15 G (chlorpyrifos)	Dry Onions	141 days
	Pickling Onions	97 days
Malathion (malathion)	Snap Beans	1 day
	Red Beets	7 days
	Cabbage	7 days
	Cauliflower	7 days
	Brussel Sprouts	7 days
	Broccoli	3 days
	Celery	7 days
	Eggplant	3 days
	Cucumbers	3 days
	Lettuce (leaf)	14 days
	Lettuce (head)	3 days
	Potatoes	3 days
	Radish	7 days
	Rutabagas	7 days
	Tomatoes	3 days
	Pepper	3 days
Monitor (methamidophos)	Cabbage	7 days
	Cauliflower	7 days

	Broccoli	14 days
	Brussel Sprouts	14 days
	Potatoes	14 days
Rotenone	Cucumbers	1 day
	Pumpkin	1 day
	Squash	1 day
Sevin (carbaryl)	Sweet Corn	1 day
	Eggplant	1 day
	Potatoes	7 days
	Radish	7 days
	Beans (snap)	3 days
	Celery	3 days
	Carrots	1 days
	Lettuce (head)	3 days
	Lettuce (leaf)	14 days
	Tomatoes	1 day
Supracide (methidathion)	Potatoes	14 days
Thiodan (endosulfan)	Cabbage	7 days
	Caulifower	7 days
	Broccoli	7 days
	Brussel Sprouts	7 days
	Cucumbers	2 days
	Eggplant	2 days
	Potatoes	1 day
	Rutabagas	45 days
	Tomato	2 days
	Beans (snap)	2 days
	Celery	14 days
	Corn (sweet)	50 days
	Peppers	2 days
	Pumpkin	2 days
	Squash	2 days
	Cucumber	2 days
	Head Lettuce	14 days

Bee Poisoning

Pollinating insects, especially honeybees and wild bees are necessary for the production of some vegetable crops. It is therefore important for the grower to refrain as much as possible from poisoning bees foraging on these crops when bloom is present.

An insecticide application on any crop which is likely to poison neighborhood bees should be of concern to a vegetable grower.

The following are a few points to consider and remember in the prevention of bee poisoning.

1. Do not spray any flowering crop on which bees are foraging. If insecticides must be applied, spray in the early morning or in evening when bees are not foraging. Bees usually do not forage at temperatures under 13°C.
2. If it is necessary to apply an insecticide poisonous to bees when they are foraging, notify neighboring beekeepers so they may protect their bees.
3. Do not apply insecticide on windy days as drift toward any nearby beehives may cause poisoning.
4. Ground applications are generally less hazardous than aircraft applications and there is usually less drift.
5. Where there is a choice and bees will possibly be poisoned choose the formulation less hazardous to bees. Dusts are more toxic than sprays. EC formulations are less toxic than WP formulations.

Note: *Most organophosphate and carbamate insecticides are highly toxic to bees. Those insecticides used in vegetable production and which are toxic to bees are listed below:*

Relative Toxicity of Insecticides to Honeybees

Group 1—Very toxic; Do not apply to flowering crops or weeds.

Ambush (permethrin)
Belmark (fenvalerate)
Dasanit (fensulfothion)
Diazinon (Diazinon)
Dimethoate (Cygon)
Furadan (carbofuran)
Guthion (azinphosmethyl)
Lannate (methomyl)
Lorsban (chlorpyrifos)
Monitor (methomidophos)
Sevin (carbaryl)
Supracide (methidathion)

Group 2— Apply only during late evenings or early morning when bees are not foraging. See note below.

Thiodan (endosulfan)

Malathion (malathion)

Note: *Unusually low temperatures at time of application may cause insecticides to remain toxic up to 20 times longer than during reasonably warm weather. High temperatures in the early morning or late evening may extend active foraging by bees and adversely affect bees on treated crops.*

ALL OTHER INSECTICIDES LISTED IN THIS GUIDE CAN BE APPLIED AT ANY TIME WITH REASONABLE SAFETY TO BEES.

Effect of Rainfall on Herbicide Efficacy

Rainfall shortly after application of a postemergence herbicide may reduce weed control. This table summarizes available information.

Product	**Interval Required***
Buctril M	30 minutes
Torch DS	30 minutes
Pardner	30 minutes
Hoe Grass 284	1 hour
TCA	1 hour
Fusilade	2 hours
Lexone	2 hours
Dalapon	4 hours
2,4-D Amine	4 hours
Banvel, Dyvel	4 hours

Roundup	6 hours
Sencor	6 hours
Kil-mor	6 hours
Basagran	8 hours
Amitrol T	8 hours

Gramoxone— very rapidly absorbed by foliage. Very resistant to removal by rain.

* *Time required between application and rainfall to avoid significant reduction in efficacy.*

Soil Residues — Herbicides

Some herbicides recommended for vegetable crops leave a residue in the soil, affecting subsequent crops in the rotation. Where growers rent land for vegetable and potato production, a detailed history of herbicide application rates and dates is strongly recommended.

The following table summarizes available information. Refer to product labels for specific information.

Product	Vegetable Crops Which May Be Affected The Following Year
Atrazine (includes all products containing atrazine)	All crops except corn. Flax, peas and faba beans have some tolerance to atrazine residues. If rate of application exceeds 1.1 kg/ha active only corn should be grown the following year. Atrazine residues may persist for more than one year.
Lexone (preplant)	All crops except potatoes.
Lontrel	Due to limited availability of recropping data for horticulture crops, only wheat, barley, rye, oats, canola (rapeseed) or flax should be grown the year after application. Lontrel may persist for 2 or more years at levels that may cause injury to sensitive crops.
Primextra	All crops except corn. Primextra contains atrazine. See comment for atrazine.
Princep Nine-T Simadex, Simazine	All crops except asparagus. Soil residues may persist for two or more years.
Rival, Treflan Triflurex	Red beets, cucumbers, onions, parsnips and potatoes. Corn may also be sensitive to higher rates of application.
Sencor (preplant)	All crops except potatoes
Sinbar	All crops except established alfalfa as recommended. Sinbar residues may persist for two or more years.
Tordon 202C	Several broadleaf crops, including beans, peas, lentils and potatoes should not be planted until the 5th growing season after application.

CAUTION: Tordon 202C residues may persist for 2 or more years at levels that may cause injury to horitcultural crops. **Tordon 202C is not recommended, for use on farms where horticultural crops are included in crop rotation, to avoid the risk of crop injury.**

Herbicides and Liquid Fertilizer Compatibility

The mixing of herbicides in liquid fertilizer for application should be carried out only for products which are recommended for this use.

Thorough mixing and even application are required. Accurate calibration should be carried out to ensure the proper rate of herbicide application.

Compatibility of the herbicide in the liquid fertilizer should be tested before the herbicide is added to the tank. All registered products outline this procedure.

The following vegetable crop herbicides can be applied with liquid fertilizer:

Aatrex	Eradicane 8-E
Primextra	Ro-Neet 7.2E
Dual-Ciba-Geigy	Sutan (alone or with Aatrex)
Eptam	Treflan

Weed Control — Stale Seedbed

Crops Beans (all types), beets, brussel sprouts, carrots, cabbage, cauliflower, corn, cucumbers, kale, onions, peas, potatoes, rutabagas.

Method Prepare seedbed two to four weeks before seeding to stimulate weed growth. Seed without further cultivation and with minimum disturbance of the soil. Emerged weeds must be burned off with Gramoxone either before or shortly after seeding, but no later than three days before the crop will emerge.

Gramoxone (200 g/L) Controls annual grasses and broadleaf weeds and top growth of perennial weeds. Apply 2.75 to 5.5 L/ha in 300 to 1100 L/ha clean water preemergent to the crop, postemergent to the weeds. Use the higher rate when weeds are above 5 cm in height, and the higher volume of water on dense weed growth.

Formulation Abbreviations

E = Emulsion, emulsible
EC = emulsifiable concentrate
W = wettable
WP = wettable powder

General Pesticide Recommendations

For Proper Pesticide Use

- Identify the Pest Problem
- Use the Recommended Pesticide
- Apply According to Directions

Insect Control

Slugs For control on most vegetable crops apply metaldehyde. **Caution** — Chemical should not be sprayed or sprinkled on vegetable crop foliage. Order ahead of time since companies do not generally stock supplies. Material should not be held over as it deteriorates quite rapidly.

Cutworms For control apply the following chemicals according to label recommendations.

— Lorsban 4C or 4E on broccoli, brussel sprouts, cabbage, cauliflower, celery, cucumber, green peppers, bulb onions, potatoes, sweet corn and rutabagas

— Ambush on asparagus, beets, carrots, cole crops, sweet corn, lettuce, onions, peppers, potatoes.

Onion maggots For control of onion maggots apply Lorsban 15G, as a furrow treatment with seed, according to label recommendations. Use only with dry seeded onions which are Pro-Gro treated.

Grasshoppers Apply Malathion 50 EC at 1.7 L/ha (24 fluid ounces/acre).

Weed Names — Cross Reference

Names in **BOLD CAPITAL** letters are those which appear in Table 1 — Herbicide Recommendations for Weed Control in Vegetable Crops. All names by which those weeds are known are listed alphabetically in left column.

WEED NAME	SEE
Annual sow thistle	**SOW THISTLE (ANNUAL)**
Ball Mustard	**MUSTARD (BALL)**
BARNYARD GRASS	
Bee nettle	**HEMP NETTLE**
BINDWEED (FIELD)	
Black bindweed	**BUCKWHEAT (WILD)**
BLUEBUR	
Blue weed	**BLUEBUR**
Bottle grass	**FOXTAIL (GREEN)**
Brittle stem hempnettle	**HEMP NETTLE**
BUCKWHEAT, TARTARY	
BUCKWHEAT, WILD	
Burning bush	**KOCHIA**
Burweed	**BLUEBUR**
Burweed	**COCKLEBUR**
Bur-forget-me-not	**BLUEBUR**
Burweed marsh elder	**RAGWEED, FALSE**
Butter and eggs	**TOAD FLAX**
Buttonbur	**COCKLEBUR**
Canada thistle	**THISTLE (CANADA)**
CATCHFLY (NIGHT FLOWERING)	
Careless weed	**RAGWEED, FALSE**
Charlock	**MUSTARD (WILD)**
CHICKWEED, COMMON	
China cockle	**COW COCKLE**
Climbing bindweed	**BUCKWHEAT (WILD)**
Clotbur	**COCKLEBUR**
COCKLEBUR	
Cockle, cow	**COW COCKLE**
Common chickweed	**CHICKWEED, COMMON**
Common groundsel	**GROUNDSEL, COMMON**
Common horsetail	**FIELD HORSETAIL**
Common purslane	**PURSLANE**
Common sow thistle	**SOW THISTLE (ANNUAL)**
Corn bindweed	**BUCKWHEAT, WILD**
Couch grass	**QUACKGRASS**
COW COCKLE	
Cow-herb	**COW COCKLE**
Cow soapwort	**COW COCKLE**
Creeping Jenny	**BINDWEED (FIELD)**
Creeping sow thistle	**SOW THISTLE (PERENNIAL)**
Creeping thistle	**THISTLE (CANADA)**
Crunchweed	**MUSTARD, WILD**
Dog Mustard	**MUSTARD (DOG)**
Dog nettle	**HEMP NETTLE**
Ditchbur	**COCKLEBUR**
Dullseed cornbird	**BUCKWHEAT, WILD**
Eggs and bacon	**TOAD FLAX**
European bindweed	**BINDWEED (FIELD)**
European glorybind	**BINDWEED (FIELD)**
European sticktight	**BLUEBUR**
European stickweed	**BLUEBUR**
False ragweed	**RAGWEED, FALSE**
Fanweed	**STINKWEED**
Fat-hen	**LAMB'S QUARTERS**
Field bindweed	**BINDWEED, FIELD**
FIELD HORSETAIL	
Field kale	**MUSTARD, WILD**
Field mustard	**MUSTARD, WILD**
Field pennycress	**STINKWEED**
Field sow thistle	**SOW THISTLE (PERENNIAL)**
Field thistle	**THISTLE (CANADA)**
Flaxweed	**TOAD FLAX**
FLIXWEED	
Flowering nettle	**HEMP NETTLE**
FOXTAIL (GREEN)	
FOXTAIL (YELLOW)	
Frenchweed	**STINKWEED**
Giant ragweed	**RAGWEED, GIANT**
GOOSEFOOT (OAK LEAVED)	
Great ragweed	**RAGWEED, GIANT**
Green amaranth	**PIGWEED, RED-ROOT**
Green bristle grass	**FOXTAIL (GREEN)**
Green foxtail	**FOXTAIL (GREEN)**
Green smartweed	**SMARTWEED, LADY'S THUMB**
GROUNDSEL, COMMON	
Hare's ear mustard	**MUSTARD (HARE'S EAR)**
Hedgehog-burweed	**COCKLEBUR**
HEMP NETTLE	
Hogweed	**RAGWEED, COMMON**
Horse pipes	**FIELD HORSETAIL**
Horsetail, field	**FIELD HORSETAIL**

Indian mustard ..... **MUSTARD, INDIAN**
Ironweed ..... **HEMP NETTLE**
Jointed charlock ..... **WILD RADISH**
Kinghead ..... **RAGWEED, GIANT**
KNOTWEED (PROSTATE)
KOCHIA
Lady's thumb ..... **SMARTWEED, LADY'S THUMB**
LAMB'S QUARTERS
Lamb's quarters goosefoot ..... **LAMB'S QUARTERS**
Leafy euphorbia ..... **SPURGE, LEAFY**
Leafy spurge ..... **SPURGE, LEAFY**
LETTUCE, PRICKLY
Low pigweed ..... **PURSLANE**
Mare's tail ..... **FIELD HORSETAIL**
Marsh elder ..... **RAGWEED, FALSE**
Mexican burning bush ..... **KOCHIA**
Mexican fireweed ..... **KOCHIA**
MILKWEEDS
Mithridate mustard ..... **STINKWEED**
Mock cypress ..... **KOCHIA**
Moench ..... **SMARTWEED, LADY'S THUMB**
Mother's heart ..... **SHEPHERD'S PURSE**
MUSTARD (BALL)
MUSTARD (DOG)
MUSTARD (HARE'S EAR)
MUSTARD, INDIAN
MUSTARD, TUMBLE
MUSTARD, WILD
MUSTARD, WORMSEED
Nettle, hemp ..... **HEMP NETTLE**
Neslia ..... **MUSTARD (BALL)**
Night-flowering catchfly ..... **CATCHFLY (NIGHT FLOWERING)**
Night flowering silene ..... **CATCHFLY (NIGHT FLOWERING)**
Pale persicaria ..... **SMARTWEED, LADY'S THUMB**
Pale smartweed ..... **SMARTWEED, LADY'S THUMB**
Pennycress ..... **STINKWEED**
Pepper plant ..... **SHEPHERD'S PURSE**
Perennial snapdragon ..... **TOAD FLAX**
Perennial sow thistle ..... **SOW THISTLE (PERENNIAL)**
PERSIAN DARNEL
Pick pocket ..... **SHEPHERD'S PURSE**
Pigeon grass ..... **FOXTAIL (GREEN)**
Pigweed ..... **LAMB'S QUARTERS**
PIGWEED, PROSTATE
PIGWEED, RED ROOT
PIGWEED, RUSSIAN
PIGWEED, TUMBLE
Portulaca, Wild ..... **PURSLANE**
Prairie ragweed ..... **RAGWEED, FALSE**
PURSLANE
Pursley ..... **PURSLANE**
Pusley ..... **PURSLANE**
Pussley ..... **PURSLANE**
QUACKGRASS
Quitch grass ..... **QUACKGRASS**
Quick grass ..... **QUACKGRASS**
Rabbit's ear ..... **MUSTARD (HARE'S EAR)**
Radish, wild ..... **WILD RADISH**
RAGWEED, COMMON
RAGWEED, FALSE
RAGWEED, GIANT
Ramsted ..... **TOAD FLAX**
Red belvedere ..... **KOCHIA**
Red-root ..... **PIGWEED, RED ROOT**
Redroot amaranth ..... **PIGWEED, RED ROOT**
Redroot pigweed ..... **PIGWEED, RED-ROOT**
Rocketweed ..... **MUSTARD (DOG)**
Roman wormwood ..... **RAGWEED, COMMON**
Rough pigweed ..... **PIGWEED, RED-ROOT**
Russian cactus ..... **THISTLE (RUSSIAN)**
Russian thistle ..... **THISTLE (RUSSIAN)**
Russian tumbleweed ..... **THISTLE (RUSSIAN)**
Scutch grass ..... **QUACKGRASS**
Sheep bur ..... **BLUEBUR**
Sheepbur ..... **COCKLEBUR**
Shepherd's pouch ..... **SHEPHERD'S PURSE**
SHEPHERD'S PURSE
Short ragweed ..... **RAGWEED, COMMON**
Small-flowered morning glory ..... **BINDWEED (FIELD)**
Small ragweed ..... **RAGWEED, COMMON**
SMARTWEED, LADY'S THUMB
Snake grass ..... **FIELD HORSETAIL**
SOW THISTLE (ANNUAL)
SOW THISTLE (PERENNIAL)
SPURGE, LEAFY
SPURGE, THYME LEAVED
Stickseed ..... **BLUEBUR**
Stickweed ..... **BLUEBUR**
Sticky cockle ..... **CATCHFLY (NIGHT FLOWERING)**
STINKWEED
Summer cypress ..... **KOCHIA**
Tall ragweed ..... **RAGWEED, GIANT**
Tartarian buckwheat ..... **BUCKWHEAT, TARTARY**
Tartary buckwheat ..... **BUCKWHEAT, TARTARY**
THISTLE (CANADA)
THISTLE (RUSSIAN)
TOAD FLAX
Treacle mustard ..... **MUSTARD, WORMSEED**
Treacle erysimum ..... **MUSTARD, WORMSEED**
Tumbling mustard ..... **MUSTARD, TUMBLE**
Twitch grass ..... **QUACKGRASS**
VOLUNTEER CORN
VOLUNTEER RAPESEED, MUSTARD
VOLUNTEER WHEAT, BARLEY
White Charlock ..... **WILD RADISH**
White goosefoot ..... **LAMB'S QUARTERS**
Wild buckwheat ..... **BUCKWHEAT, WILD**
Wild hemp ..... **HEMP NETTLE**
Wild millet ..... **FOXTAIL (GREEN)**
Wild mustard ..... **MUSTARD, WILD**
WILD OATS
Wild portulaca ..... **PURSLANE**
WILD PROSO MILLET
WILD RADISH
Wild snapdragon ..... **TOAD FLAX**
Wild turnip ..... **WILD RADISH**
Wolf's milk ..... **SPURGE, LEAFY**
Wormseed mustard ..... **MUSTARD, WORMSEED**
Yellow toad flax ..... **TOAD FLAX**
Yellow weed ..... **MUSTARD (BALL)**

Fertility

General Fertility Recommendations

Most crops when the available nutrient level of soil is low, respond well to fertilizer. Stubble fields are usually low in nitrogen and phosphorus. Fallow fields usually have adequate nitrogen but are low in phosphorus. Many fields may be low in sulphur and some may be low in potassium. On the other hand, where high rates of fertilizer have been used for a number of years the level of available nutrients may be adequate to meet crop requirements.

Recommendations for maximum rates of fertilizer which can safely be applied with the seed have been established with granular fertilizers using double disc drill seeding equipment. Using this method, fertilizer is placed in close proximity to the seed. Discers, hoe-drills and air seeders vary in their ability to accurately place seed and fertilizer. This means some discretion may be used in increasing recommended maximum rates of fertilizer with the seed if contact between fertilizer and seed is less than that with a double disc drill. Safe rates of fertilizer, applied with the seed may also increase if fertilizer is applied in solution form rather than as granular fertilizer.

For specific recommendations on individual fields, have your soil analyzed. Details of sampling procedures may be obtained from your agricultural representative's office or your fertilizer dealer. Cost of routine testing ranges from $8.00 to $16.00 depending on tests required. Send your soil sample to:

Provincial Soil Testing Laboratory
Ellis Building
University of Manitoba
Winnipeg, Manitoba R3T 2N2

For further details, see Manitoba Agriculture Fact Sheet *"Soil Testing Services in Manitoba"* Agdex 533.

Major Nutrients For Annual Crop Production

Nitrogen Nitrogen fertilizer is effective in increasing both yield and protein content. Its value in increasing yield and/or protein content is significantly affected by the time of application and method of placement. The various nitrogen carriers appear to be equally effective in increasing yields and/or protein content of annual crops when applied so that nitrogen losses are minimized. The greatest efficiency of all nitrogen fertilizers is obtained when the fertilizers are banded into the soil or applied in the seed row.

Urea and liquid or dry fertilizers containing urea should be well covered with soil to minimize losses. Apply anhydrous ammonia and aqueous ammonia at depths of 10 to 15 cm (4 to 6 inches) when soil conditions permit a good seal behind the applicator shanks. When crop is seeded less than five days after applying anhydrous ammonia and aqua ammonia, damage may occur specifically on sandy soil or under dry conditions.

The relative efficiency of nitrogen fertilizers as affected by time of application and method of placement varies greatly from year to year. *The average relative value of times and methods of application, when spring broadcast nitrogen is given a value of 100, can be calculated and are as follows:*

Time and Method	Relative Value
Spring broadcast	100
Spring banded	120
Fall broadcast	82
Fall banded	93

Losses of nitrogen due to leaching, gaseous loss, immobilization and weed growth are probably higher for fall applied than for spring applied nitrogen and this accounts for the differences in efficiencies between fall and spring indicated above.

These losses may be greater if the nitrogen is applied too early in the fall (prior to mid September) or when soil temperatures at the 10 cm (4 inch) depth are greater than 5°C.

For further details, see the Manitoba Agriculture fact-sheet *Nitrogen Fertilization in Crop Production,* Agdex 541.

Phosphorus Most Manitoba soils are phosphorus deficient and will give yield responses to fertilizer phosphorus application. A crop's response to phosphorus is affected by factors such as root development and distribution, the plant's ability to take up soil and fertilizer phosphorus, the method of phosphorus application, the soil available phosphorus level, soil type (soil texture, pH and carbonate content), soil water and temperature.

Ideally, plants should have a good supply of phosphorus close to the seed during the first month of growing and an adequate quantity of phosphorus in the soil for the rest of the season. Placing sufficient quantities of phosphorus with the seed or close to the seed have been the traditional methods for phosphorus fertilization of annual crops in Manitoba. They have been found to satisfy both early growth requirements and provide a reserve of phosphorus for the balance of the growing season.

CAUTION: By increasing the phosphorus applied annually above that normally recommended (banded or broadcast) an increase in soil available phosphorus results. Thus, a farmer could increase soil available phosphorus to high or very high levels so that yields would not be significantly affected by phosphorus deficiency. The number of applications or years of phosphorus fertilizer required to increase soil available phosphorus to high or very high levels is unknown for most soils. Soil testing at regular intervals is a good way to monitor the available phosphorus level.

High rates of applied fertilizer phosphorus (annual rates in excess of 150 kg/ha (134 lb/acre) of P_2O_5 may induce a micro-nutrient deficiency if soil levels of micro-nutrients are marginal (for example, zinc and copper).

Phosphorus Banded with the Seed Banding of fertilizer phosphorus with the seed results in the greatest yield increase per unit of phosphorus for all crops pro-

vided that the amount applied is not injurious to the germinating seedling. Some crops will tolerate all their fertilizer phosphorus requirements placed with the seed.

Phosphorus Banded Near the Seed Banding fertilizer phosphorus near the seed (beside and/or below) results in the greatest yield increase per unit of phosphorus when amounts in excess of those tolerated with the seed are required.

Phosphorus Deep-banded Deep banded phosphorus; phosphorus banded at about the 10 to 15 cm (4 to 6 inches) soil depth and in spacings of 30 cm (12 inches) or less prior to seeding is more effective in increasing yields than phosphorus broadcast and incorporated. Nitrogen applied with the phosphorus will increase fertilizer phosphorus availability. Band these fertilizers together when both nitrogen and phosphorus are needed. Application of 10 to 15 kg P_2O_5/ha (9 to 13 lb/acre) with or near the seed may also be required to insure adequate supplies of phosphorus for early growth.

Note: Take care not to disturb the bands during tillage and seeding operations.

Phosphorus Surface Applied and Incorporated Surface incorporation of fertilizer phosphorus results in the lowest yield increase per unit of phosphorus. As a result the amount applied broadcast must be greater than amounts applied with or near the seed to obtain equal yield increases in the year of fertilizer application.

Since the amount of phosphorus applied during the first number of years has to be increased two or fourfold to equal yield increases from placement near the seed, broadcast application of phosphorus may be uneconomic on many soils.

For further details, see the Manitoba Agriculture factsheet *Phosphorus Fertilization in Crop Production and Phosphorus Application for Annual Crops, Agdex 541.*

Potassium Most Manitoba soils contain sufficient available potassium for most cropping situations. Soils which are most likely to contain insufficient potassium are the coarse textured soils (sands to sandy loams) and organic soils. Additional fertilizer potassium may be required on about 5 to 7 per cent of arable Manitoba soils for maximum production of the commonly grown annual crops such as cereals, rapeseed, and flax. From 25 to 40 per cent of soils used for production of special annual crops such as corn, potatoes and sugarbeets and the horticultural fruit and vegetable crops may require additional potassium. The application of potassium where required, can increase crop yield and quality and, depending on the type of crop, can increase frost and disease resistance, palatability, storage, quality, etc. A soil test is recommended to determine if a potassium application is needed in any specific situation.

Within the limits allowable for each crop, place potassium fertilizers in the seed row or side banded whenever possible for most efficient use of fertilizer by annual crops. The efficiency of broadcast potassium is about one-half of that applied with the seed. If potassium is to be broadcast, the rate of application should be double that of the rate recommended for seed placement or side banding to obtain equal crop response. If broadcast, potassium fertilizer should be incorporated into the soil.

Sulphur For many years it has been recognized that well drained sandy soils and grey luvisol (grey wooded) soils may be sulphur deficient. More recent results of soil analyses indicate that sulphur deficiency occurs in many other soils and in most areas of the province. Because of this it is recommended that farmers have a soil test to establish the available sulphur status of their fields.

Crops vary greatly in their sulphur requirements. Rapeseed, mustard, corn, potatoes, sugarbeets, horticultural crops, and forages containing a legume component have a higher sulphur requirements than crops such as cereal grains and flax. Sulphur deficiencies are more likely to occur with crops having a high sulphur requirement. These crops also have a greater tendency to deplete the sulphur in the soil resulting in a low supply of available sulphur for subsequent crops. This is particularly true following breaking of a perennial forage stand.

Sulphur fertilizer recommendations are based on sulphur being applied in the **sulphate** ($SO_4=$) form as this is the only form which is readily available to plants. Some nitrogen and phosphorus containing fertilizers also contain sulphate sulphur, for example, 21-0-0 (24S) and 16-20-0 (14S). Sulphur in the elemental form, as it occurs in some fertilizers, is not available to plants until it has been oxidized to the sulphate form.

Sulphur in the elemental form, as it occurs in some high analysis sulphur products such as flaked or prilled elemental sulphur (99% S), flowers of sulphur (99% S) or granular sulphur (90% S) is not available to plants until oxidized to the sulphate form. Oxidation of sulphur requires time and depends on soil temperature and moisture, size of sulphur granule and the rate at which granules break down in the soil. Recent research has found that sulphur from these products does not become available in sufficient quantities to meet crop requirements in the year of application. Therefore, they are not recommended to be applied on soils with a low available sulphur content where the crops would require the applied sulphur to be available in the immediate year of application.

Ammonium thiosulphate is a liquid formulation (12-0-0 (26)) containing 26 per cent sulphur by weight. One-half of the sulphur converts into the readily available sulphate form and the remainder into finely divided elemental sulphur. This product can be applied to supply sulphur at the rate recommended for sulphate sulphur.

Micro-Nutrients Most of Manitoba's mineral soils contain sufficient micro-nutrients for most crops. Do not apply micro-nutrient fertilizers unless it is established that deficiences exist. Consult with extension agronomists and make use of soil test results.

The Manitoba Soil Testing Laboratory offers a soil micronutrient analysis service. The cost for a copper-zinc-iron-manganese soil analysis is $7 per field, if in addition to a routine soil test, these tests are performed only when specifically requested. Proper soil sampling and sample handling procedures are important.

Additional information is contained in the Manitoba Agriculture factsheet *Micro-nutrients in Crop Production*, Agdex 541.

Plant Tissue Analysis The Manitoba Soil Testing Laboratory offers a Plant Tissue Analysis Service. Plant tissue analysis is useful in evaluating fertilizer management programs and practices, diagnosing nutrient related crop production problems, and identifying nutrient levels in crops that may limit top yield achievement. Plant Tissue Analysis is particularly useful in evaluating and identifying potential micronutrient problems.

The cost of a Plant Tissue Analysis ranges from $2.50 per sample for an individual nutrient analysis to $16.50 for a complete 10 nutrient analysis. Proper plant sampling and sample handling procedures are important.

Detailed information on Plant Tissue Analysis and complete instructions for sampling procedures are contained in the Manitoba Agriculture factsheet *Plant Tissue Analysis*, Agdex 533.

Organic Soils Most organic soils are very deficient in phosphate and potassium. Farmers on organic soils should use the higher rates of phosphate and potassium recommended in this booklet for each crop.

Organic soils are frequently deficient in copper and may also be deficient in manganese and boron. Use both soil and plant analyses as aids in determining if these micro-nutrients are deficient. Conduct small scale trials (micro-nutrients applied to portions of a field) to assess the effects of micro-nutrient fertilizers on crop yields before micro-nutrients are used on large land areas. Recommendations for micro-nutrient fertilizer use in these trials and in instances where deficiencies exist are:

Copper Apply 5 to 15 kg/ha (4 to 13 lb/acre) copper, (for example, 20 to 60 kg/ha, 18 to 54 lb/acre copper sulphate). Spray dissolved copper sulphate and incorporate well into the surface 15 cm (6 inches) of soil. Research indicates that applying copper fertilizer in the solution form is superior to its application in granular form. After soils have been fertilized two or three times with copper, have both a soil and a plant analyses to determine if excessive copper accumulation has occurred.

Manganese 10 to 15 kg/ha (9 to 13 lb/acre) manganese, (for example, 40 to 60 kg/ha, 36 to 54 lb/acre manganese sulphate) should be drilled with the seed of cereals and banded away from the seed of rapeseed and grasses.

Boron Incorporate 1 to 2 kg/ha (1 to 2 lb/acre) boron, (for example, 9 to 17 kg/ha, (8 to 15 lb/acre) borox with the surface 15 cm (6 inches) of soil.

Calculation of Fertilizer Rates Fertilizers are labelled by percentage according to their guaranteed minimum analysis in terms of Nitrogen (N), phosphate (P_2O_5) and potash (K_2O). For example, 16-20-0 (14) contains 16 per cent nitrogen by weight, 20 per cent phosphate by weight and 0 per cent potash by weight, and approximately 14 per cent sulphur by weight. The actual weight of nutrients in 100 kg (220 lb) of fertilizer is: N = 16 kg, (35 lb), P_2O_5 = 20 kg (44 lb) and K_2O = 0 kg, and S = 14 kg (31 lb) approximately.

For example:

1. Using 34-0-0

   Rate of N desired = 45 kg/ha (40 lb/acre)

   Rate of fertilizer required = $\frac{45 \times 100}{34}$ = 132 kg/ha

   = $\frac{(40 \times 100)}{(34)}$ = (117 lb/acre)

2. Using 16-20-0-(14)

   Rate of P_2O_5 desired = 22 kg/ha (20 lb/acre)

   Rate of fertilizer = $\frac{22 \times 100}{20}$ = 110 kg/ha

   = $\frac{(20 \times 100)}{(20)}$ = (100 lb/acre)

   110 kg/ha (100 lb/acre) of 16-20-0(14) would also supply nitrogen at the rate of

   $\frac{16 \times 110}{100}$ = 17.6 kg/ha; $\frac{(16 \times 100)}{100}$ = (16 lb/acre)

   and sulphur at the rate of

   $\frac{14 \times 110}{100}$ = 15.4 kg/ha; $\frac{(14 \times 100)}{(100)}$ = (14 lb/acre)

Additional information is contained in the Manitoba Agriculture factsheet *Calculating Nutrient Costs and Fertilizer Rates*, Agdex 540.

Fertilizer Analysis

Note: *The number in brackets denotes the approximate percentage of sulphur in the fertilizer.*

Liquids (solutions)

Ammonium phosphate	10-34-0
Nitrogen solution	28-0-0, 32-0-0
Aqua ammonia	20-0-0
Ammonium Thiosulphate	12-0-0 (26)

Gas (compressed)

Anhydrous ammonia	82-0-0

Dry (solids)

Ammonium phosphate	11-51-0; 11-55-0
Ammonium phosphate sulphate	16-20-0 (14)
Urea ammonium phosphate	19-39-0
Diammonium phosphate	18-46-0
Ammonium nitrate phosphate	23-23-0; 23-24-0; 24-24-0; 25-25-0
Urea ammonium phosphate	27-27-0; 34-17-0
Ammonium nitrate phosphate sulphate	26-13-0 (13)
Ammonium nitrate phosphate	27-14-0; 28-14-0
Ammonium sulphate	21-0-0 (24)
Ammonium nitrate	34-0-0
Urea-ammonium sulphate	34-0-0 (11)
Sulfur-coated urea	40-0-0 (6); 36-0-0 (20)
Urea	46-0-0
Mixed fertilizers	8-24-24 (3); 8-25-25; 10-30-10 (5); 10-34-10; 17-17-17
Potassium chloride	0-0-60, 0-0-62
Calcium sulphate (gypsum)	0-0-0 (13-19)
Sulphur (clay base)	0-0-0 (90)

In addition to these pre-mixed fertilizers, micronutrients and blended fertilizers including suspensions are available from some fertilizer dealers.

Irrigation

Irrigation Management

Adequate irrigation produces top yields and top quality produce. Most crops give the best yields and make the most efficient use of water when soil moisture is near optimum level. The tubers and bulbs of some crops such as potatoes and onions will have a higher dry matter content when they receive optimum irrigation than when under-irrigated. Over irrigation will cause delayed growth and maturity, and in some cases may encourage the development of disease and lead to the development of soil salinity problems.

The amount and frequency of irrigation depends upon the kind of crop, the stage of development of the crop, the water holding capacity of soil, soil profile uniformity and the climate. The climatic factors include: temperature, sunlight, wind, rainfall and relative humidity.

Vegetable crops which have small seeds may require light and frequent water applications to enhance emergence of seedlings. This is particularly important where soil crusting is a problem. These light water applications should wet the top layer of the soil only (10 mm or 0.40 in. of water per application should be sufficient). If more water is applied it will increase crusting and will not keep the surface of the soil moist any longer than a light water application. Light water applications can be achieved successfully by using sprinkler irrigation systems. However, it is important to have sprinkler nozzles of proper size and maintain desirable operating pressure to avoid large droplets, which cause soil compaction. Irrigation at other than the hot period of the day will also help reduce crusting of the soil.

The available moisture for crop use varies with the soil texture.

Loamy sand	8-12 mm/0.1m (0.9-1.4 in/ft)
Sandy loam	10-15 mm/0.1m (1.2-1.8 in/ft)
Loam	14-18 mm/0.1m (1.7-2.1 in/ft)
Sandy clay loam, clay loam, clay	15-20 mm/0.1m (1.8-2.4 in/ft)
Silty clay loam, silt loam	16-22 mm/0.1m (1.9-2.6 in/ft)

(mm — millimetre, m — metre)

The depth from which crops can effectively draw moisture varies with each crop. The allowable depletion (AD) of soil moisture varies with the crop and to a lesser extent the stage of crop development. Allowable depletion is a level of dryness that the plants can tolerate and still produce the desired yield. It is usually expressed as the percent of available moisture in the root zone. (See following table)

The recommended allowable depletion for vegetable crops is as little as 25% of available moisture and as much as 50%. The most critical period to avoid moisture stress is from flowering through seed formation, or during head, bulb or tuber development. The result of irrigating crops inadequately during the critical period is a lower yield and poorer quality produce.

The timing of irrigation of a vegetable crop and the amount of water to be applied at each irrigation, depend upon both the crop rooting depth and the amount of moisture stress the crop can tolerate.

Example 1 — A shallow rooted crop like onions can effectively draw moisture from 0.6 m (2 ft) depth. However, yield is reduced if allowable depletion exceeds 35%. A loam soil holds 17mm/0.1 m (2 in/ft) of available moisture. This amounts to 102 mm (4 in) in the root zone of 0.6 m (2 ft).

Since the allowable depletion is 35%, then 36 mm (1.4 in) of water will be depleted. In mid-summer onions use about 5 mm (0.2 in) per day; therefore irrigation is required every seventh or eighth day (assuming no rainfall occurred and normal crop growth and development is taking place) by applying 36 mm (1.4 in) net of water. However, early in July onions use less than 4 mm (0.16 in) per day and then irrigation is required every ninth or tenth day.

Example 2 — Carrots have an effective rooting depth close to one metre (3 ft) and have a higher soil moisture allowable depletion of 40%. If carrots are grown on a sandy loam soil which has a moisture holding capacity of about 10 mm/0.1 m (1.2 in/ft), the root zone of 0.9 m holds 90 mm (3.5 in) of available moisture. Since allowable depletion is 40% this means that 36 mm (1.4 in) can be depleted between irrigations without putting the crop under stress. At the beginning of July carrots use about 4 mm/day (0.16 in) and toward the end of July increases to about 6 mm (0.24 in) per day.

Financial Assistance

Two programs exist to provide financial assistance for the development of irrigation systems. One is a federal program, administered by PFRA. The grant is based on 1/3 of eligible costs to a maximum of $2200 per system. PFRA offices are in Brandon, Dauphin and Morden. The second program is a provincial one, administered by Soils and Crops Branch, Manitoba Agriculture. The rebate is based on 30% of eligible costs to a maximum of $2000. For further information contact Larry Slevinsky, Soils and Crops Branch in Winnipeg, 945-2161.

Water Licencing

According to the Water Rights Act, pumping water for irrigation, regardless of the water source, requires licencing. The contact person is George Swift (945-6699), Water Resources 1577 Dublin Avenue, Winnipeg, MB R3E 3J5.

Note: *Some of the above Irrigation material was taken from the 1983-84 Alberta Vegetable Production Guide, with permission.*

Irrigation Requirements of Vegetables

CROP	Rooting Depth metres (ft)	Allowable Depletion of Available Moisture (%)	Comments
Beans (fresh market)	0.9 (3 ft)	40	Beans are sensitive to moisture stress during the period of flowering to seed formation. A waterlogged soil during flowering or pod formation stages will reduce seed yields and encourage the development of diseases.
Beans (dry beans)	0.9 (3 ft)	50	
Beets	0.9 (3 ft)	50	
Broccoli	0.6 (2 ft)	40	Broccoli and cabbage are most sensitive to moisture stress at the time of head formation and enlargement.
Carrots	0.9 (3 ft)	40	Several small applications of water near the time of emergence will aid in obtaining a uniform stand. Carrots are sensitive to moisture stress during the root enlargement period. In fall, an excessively wet soil will encourage the development of soft rots.
Corn (sweet)	1.0 (3.2 ft)	40	Corn is sensitive to moisture stress from tassel to seed formation stages.
Cucumbers	0.6 (2 ft)	50	Available soil moisture should be kept above 60% after flowering begins.
Lettuce	0.6 (2 ft)	25	Lettuce is sensitive to moisture during head formation. Excessive moisture in the seedling stage may cause seedlings to die off.
Onions	0.6 (2 ft)	35	Irrigation water (light applications) may be needed early in the spring to aid the emergence of onions. Moisture stress during the bulb formation period will reduce the yield and the dry matter content. No watering after the third week of August to allow time for ripening of bulbs.
Parsnips	1.0 (3.2 ft)	40	
Peas	0.6 (2 ft)	30	Peas are most sensitive to moisture stress from the beginning of flowering through pod formation. Peas are sensitive to waterlogged soil.
Peppers	0.9 (3 ft)	30	Moisture stress during flowering and fruit development will reduce yields of peppers.
Potatoes	0.8 (2.5 ft)	30	Potatoes are sensitive to moisture stress from tuber formation until ripening of the vines begins. If the soil is kept moist at the time of tuber formation, this increases the number of tubers formed but reduces the average size of tubers. Late potatoes which do not suffer moisture stress will have a higher dry matter content than potatoes which have been stressed during the growing period. Potatoes grown for commercial purposes have a slightly higher allowable depletion level.
Tomatoes	0.9 (3 ft)	40	Tomatoes are sensitive to moisture stress from the time of flowering through to full enlargement of the fruit.

***A crop that has an allowable depletion of 25% of the available moisture will require irrigation twice as often as a crop that has an allowable depletion of 50% if they have the same depth of rooting and daily water use. Available moisture is the moisture that is held in the root zone between field capacity and wilting point.**

Methods of Irrigation

Trickle Irrigation

Trickle irrigation of vegetables consists of supplying water to the vegetable rows in continuous wetted strips through the use of either porous tubing or multi-chambered tubing with closely spaced outlets.

Water is applied slowly and at low pressures, typically 34 to 100 kPa (5 to 15 psi). It is known that this method of irrigation requires less water than sprinkler irrigation, but commercial scale comparisons have not been made in Manitoba.

Filtration is an important consideration in the design of a trickle system. Filtration requirements depend on water quality and on the type of tubing used.

The cost of equipment is high and annual costs are especially high because the tubing has limited life when used on annual crops like vegetables.

Sprinkler Irrigation

Sprinklers have advantages, particularly to a vegetable grower, as they are adaptable to almost any soil or topographic condition, and can apply large or small amounts of water at one time. Sprinkler systems can also provide a light application to promote germination. However, the capital and operating costs of sprinkler systems are high.

Hand move systems using portable aluminum tubing are best suited to small acreages such as market gardens. They can be used for germination, if the pressures are high enough to provide a finer droplet size. If light water applications are desired the lateral lines have to be moved often and this results in high labor requirements. In cases where the value of the crop warrants it, enough hand move laterals could be used to cover the entire field. This "portable solid set" system would be laid out in the spring and left until fall when it could be removed. Frost protection is also possible with a solid set system. The only labor involved would be the opening and closing of valves. The capital cost of the equipment would be very high compared to a portable hand move system. On small acreages, the pumping unit is the main initial cost of any sprinkler system.

Wheel roll systems are commonly used for vegetables in Manitoba. For vegetable crops, four 400 m (¼ mile) laterals per quarter section can be justified by improved yield and quality rather than the two laterals generally used with conventional field crops. Where surface crusting is a problem or when irrigation for germination is required, the nozzle size of the sprinklers could be reduced. This would result in an increased pressure and finer droplet size. Equipment costs vary depending primarily on the number of laterals that are required. Acreages smaller than a quarter section can also be irrigated with wheel roll systems, but the cost is higher and if the field is not rectangular in shape, the labor requirements are greater.

Volume guns consist of one large sprinkler which may discharge between 100 and 500 US gallons per minute (gpm). These sprinklers can be set up and allowed to operate in one spot and then moved to a new location or else they may be self-propelled. These are known as travelling volume guns. Volume guns require a high operating pressure and therefore have high energy costs, but are very adaptable to odd shaped fields and to tall crops, even for tree nurseries. The spray pattern of these guns is severely affected by wind.

Centre pivot systems are also suited to vegetable crops provided a large area free of obstruction is available. Some operators have a quarter section pivot of which one-half or one-quarter of the circle is in vegetable crops. Shorter centre pivot machines are available, and although the per acre cost is high they may be a viable alternative for vegetable crops. Major advantages of pivots are that they require a relatively small amount of labor, have the ability to operate on rough topography and have variable speed which permits light applications.

Polyethylene Films

The production of heat-loving crops can be improved by employing polyethylene (plastic) films. Crops which respond to plastic films include cucumbers, peppers, watermelon and muskmelons.

Techniques

Those recommended for commercial production in southern Manitoba include:

a) Plastic mulch. The plastic film is available in clear or opaque stock of varying widths and thicknesses which can be laid over a well prepared seed bed prior to planting. **CLEAR** plastic, 1.5 mil thickness and 1.2 metres (4 feet) width, appears to be best suited to vegetable production in Manitoba.

b) Plastic mini-tunnels. These are installed after planting and consist of clear-ventilated or shaded (white) films stretched over wire hoops in a semi-circular design. The plastic used is 2.0 mil thickness and 1.5 metres (5 feet) in width. The wire is No. 9 gauge galvanized in lengths of 1 metre (3 feet). Tunnel dimensions are 45 to 60 cm (18 - 24 inches) at the base and 45 cm (18 inches) in height.

Clear plastic will require ventilation. Ventilated plastic is commercially available, however after installation the mini-tunnel non-ventilated plastic can be ventilated by cleanly punching or burning (use butane torch) 2.0 - 2.5 cm (¾ to 1 inch) holes spaced 20 - 30 cm (8 to 12 inches) along the top and sides of the tunnel.

Soil Moisture

Moisture availability must be ample prior to the installation of plastic films. If required, thoroughly irrigate the field a few days piror to laying plastic mulch or mini-tunnels.

Seeding/Planting

Transplanting or seeding precedes the installation of mini-tunnels. Therefore, conventional seeders or transplanters can be used. Similarly, seeding operations will precede the laying of plastic mulch. However, a transplanted crop requires the placement of the plants through the plastic mulch. Specialized "mulch planters" are available and will accurately place transplants through plastic mulch.

Installation

The laying of plastic mulch has been mechanized and once installed remains so for the entire growing season.

Mini-tunnel installation has been partially mechanized. The plastic film is mechanically stretched over the supporting wire hoops which are manually placed 1.8 to 2.4 metres (6-8 feet) apart along the row. A week prior to removal mini-tunnels are slowly opened, being totally removed approximately four weeks after installation.

Both techniques require that the applicators securely anchor the polyethylene edges (at least 15 cm (6 in.) on each side) in a furrow with soil.

Removal

Plastic mulch diggers and retrievers are commercially available. These units range in function from lifting the poly film and laying it loosely back on the ground ready for pickup and disposal or baling it for immediate disposal.

For mini-tunnel removal, Manitoba Agriculture has adapted a variable speed hydraulic spool which efficiently lifts and bales the plastic.

Advantages

a) Yield — Depending on crop and variety, increases as high as 75-90% have been recorded on heat loving crops within Manitoba.

b) Maturity — Clear plastic mulch has shortened the days to crop maturity by as much as 7 days.

c) Soil temperature and moisture — Plastic mini-tunnels and mulch can increase temperature by as much as 5 - 6°C, while conserving and maintaining uniform levels of soil moisture. Higher spring soil temperatures and reduced leaching improves the availability of soluble nutrients which results in quicker plant establishment and enhanced crop vigor.

Other Considerations

1. Black or opaque polyethylene films are not recommended for vegetable production in Manitoba. The use of clear or shaded (white) plastic will allow weed growth requiring the use of a recommended herbicide.
2. Plastic mini-tunnels provide very little frost protection. Planting earlier than recommended for your area should be avoided.
3. Photo-degradable films have not performed satisfactorily in tests conducted by Manitoba Agriculture.
4. Commercial use of polyethylene film techniques will substantially increase production costs and may require technical changes involving machinery, plant populations, fertility, etc.
5. Investigate thoroughly the use of polyethylene films before proceeding extensively with the techniques. For more information contact:

   Manitoba Agriculture Vegetable Crop Specialist
   25 Tupper Streeth North
   Portage la Prairie, Manitoba R1N 3K1
   Phone 857-9711, ext. 275.

Production Recommendations

Asparagus

Varieties

Mary Washington, Lucullus (mid-season)

Seedling Production

Plant seed 2.5 to 3.8 cm (1 to 1-½ inches) deep, and 9 to 10 cm (3 to 4 inches) apart in rows 45 to 60 cm (18 to 24 inches) apart. 1.1 kg/ha (one pound) of seed should be sufficient to provide crowns for one acre. Use only strong, vigorous one year old roots (crowns) for transplanting.

Transplanting and Spacing

In the early spring following seeding, dig the year old plants and select those which have at least 10 roots. Choose fertile land that is well drained. For transplanting open a furrow 15 to 20 cm (6 to 8 inches) deep. Space plants 30 to 45 cm (12 to 18 inches) apart in rows 120 to 150 cm (4 to 5 feet) apart. Spread the roots and cover with 5 cm (2 inches) of well firmed soil. Fill the furrow gradually by cultivating as the plants grow until the furrows have been filled level with the field.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches), and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

Pre-Planting of Crowns Apply a liberal application of manure (27 tonnes or 30 tons) and 224 kg/ha 11-48-0 (200 lb/acre). Without manure apply 20 to 60 kg/ha (18 to 54 lb/acre) nitrogen, and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) phosphorus (P_2O_5) and 125 to 175 kg/ha (112 to 156 lb/acre) potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅙ of above rate and if potassium fertilizer is sidebanded above rate can be reduced by ½. 30 kg/ha (27 lb/acre) **sulphate** sulphur(S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Established Beds Apply annually, immediately after final harvest, 60 to 100 kg/ha (54 to 89 lb/acre) N, and 120 to 160 kg/ha (107 to 143 lb/acre) P_2O_5. Sands and sandy loam soils are frequently low in available potassium. On these soils broadcast 250 to 300 kg/ha (223 to 266 lb/acre) of potash (K_2O). 30 kg/ha (27 lb/acre) sulphate sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Weed Control

Before spear emergence or after last cutting.

Afolan F (450 g/L), Lorox L (480 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply Afolan F at 3.7 to 5 L/ha in 220 to 330 L/ha water or Lorox L at 3.4 to 4.5 L/ha in 300 L water. Treatment may be repeated after last cutting.

Amitrol-T (200 g/L) Controls perennial grasses and thistles. (Table 1) Apply 22 L/ha in 200 to 500 L/ha water after last cutting.

Basfapon (74%), Dalapon (74%), Dowpon (74%), Dowpon M (74%) Controls barnyard grass, green and yellow foxtail. Apply Basfapon or Dalapon at 3.25 to 6.75 kg/ha product in 200 L/ha water or Dowpon or Dowpon M at 3.4 to 6.8 kg/ha product. Apply after cutting before grasses are at the four leaf stage.

To control quackgrass in established asparagus apply Dalapon, Dowpon or Dowpon M at 11 kg/ha product before cutting and again about three to four weeks later as needed. For a single treatment apply Dalapon at 22.5 kg/ha product or Dowpon or Dowpon M at 22 kg/ha product before or after the cutting season.

Apply Basfapon at 14.5 to 22.5 kg/ha in 200 to 400 L/ha water after cutting at one week before close of the cutting season, or in October after fern removal. Disc the field after last cutting. Do not make more than one application of Basfapon per season.

Gramoxone (200 g/L) Controls annual grasses, broadleaf weeds and top growth of perennial weeds. Apply 2.75 to 5.5 L/ha in 300 to 1100 L/ha clean water to emerged weeds. Use the higher rate when weeds are above 5 cm in height, and the higher volume of water on dense weed growth. Do not apply to emerged spears which are to be used for human consumption.

Karmex (80%) Controls several grass and broadleaf weeds. (Table 1). Apply as a band or broadcast treatment. On light sandy soils or other soils low in clay or organic matter apply Karmex at 1.1 to 2.25 kg/ha product in 250 to 400 L/ha water. On soils high in clay or organic matters, use 2.25 to 4.5 kg/ha product in 250 to 400 L/ha water.

Two applications may be used; the first application should be made before weeds become established; but no earlier than four weeks before spear emergence, and no later than early cutting period (if weeds are controlled into the cutting period by cultural practices, application may be delayed until immediately after the last cultivation). A second application may be made immediately following completion of harvest provided rainfall is expected when two applications are used in one season. Do not exceed 3.25 kg/ha for application. If irrigation is used, apply only a single treatment of 4.5 kg/ha in late September or October.

Well established weeds should be eliminated by mechanical or other means. For best results, the soil should be well prepared and as free as possible from trash and clods.

Sufficient moisture in the form of rainfall or irrigation is necessary after treatment to carry the chemical into the root zone of germinating weeds.

Note: Spray booms must be shut off while starting, turning, slowing, or stopping or crop injury will occur. The soil surface should not be cultivated or disturbed after application as efficiency may be reduced and/or crop injury may result. Do not replant treated areas to any crop within two years after last application as injury to subsequent crops may result. Do not use on soils with less than 1% organic matter content.

Lorox L see Afolan F.

Princep Nine-T (90%), Simadex (500 g/L), Simadex 80 W (80%) Controls barnyard grass, wild oats and several broadleaf weeds. (Table 1) Apply Princep Nine-T at 2.5 to 3.75 kg/ha product in 300 L/ha water, Simadex at 4.5 to 6.7 L/ha in 300 L/ha water or Simadex 80 W at 2.75 to 4.25 kg/ha product in 350 L/ha water after discing in spring prior to weed and spear emergence and at least seven days before first cutting. A second application may be made after harvest completion if weeds are removed. Do not apply during cutting season.

2,4-D amine Controls perennial thistles. Apply 2.25 L/ha of formulations containing 500 g/L 2,4-D in 100 L water. Product volumes of other 2,4-D formulations are given in the *1986 Guide to Chemical Weed Control.* Apply after last cutting.

Disease Control

Rust Grow resistant varieties, Mary Washington has a good level of resistance. If rust has been severe in previous year apply one of the following: Zineb (Dithane Z-78) or metiram (Polyram 80W) at 2.2 to 3.4 kg/ha (2.00 to 3.00 lb/acre) to fern growth 10 — 14 days after last cut followed by applications every 2 weeks until late summer. Do not apply zineb or metiram to spears that are to be harvested.

Crown Rot, Seedling Blight Crowns should be treated before planting. Mix 2 g Benlate 50W per L of water 3.2 oz/gallon. Dip 3,000 crowns in 100 L (22 gallons). Do not plant on heavily infested soils. Do not cultivate deeper than 10 cm (4 inches).

Fusarium To reduce losses from this disease avoid management practices which stress the plants such as; poor fertility, diseases, over-harvesting and cultivation which may damage crowns and roots.

Irrigation

Apply 2.5 cm (1 inch) water every 10 days during harvest if an equal amount of rain is not received. To develop healthy, vigorous roots for the following year's crops apply 5 cm (2 inches) water after harvest and 2.5 cm (1 inch) water toward the end of the growing season.

Disposal of Fern

To trap snow retain asparagus fern all winter. This protects the crowns from low temperature winter injury. The fern can be cut up with a rotary or flail-type mower before light discing in early spring. Use minimum cultivation for fern disposal and weed control.

Harvest and Storage

Asparagus may be harvested on a limited scale in the third year following seeding or in the second year after planting one year old crowns. The number of cuttings can be gradually increased and extended to the later part of June by the fourth year. The spears should be cut 12 mm (one-half inch) below the soil with a sharp knife when they are 12 to 20 cm (5 to 8 inches) long.

Fresh harvested asparagus is very perishable and loses quality rapidly. Collect the spears as soon as possible, protecting them from the sun, and move to cold storage or market as soon as possible. If short term storage is necessary, store under high humidity (95%) at 1° to 2°C.

A well tended asparagus bed should be productive for 12 to 15 years.

Beans (Snap)

Varieties

Green Podded Tendercrop; Bush Blue Lake; Provider; Green pak.

Wax Podded Kinghorn; Gold Rush; Round Pod Kidney Wax; Top Notch Golden Wax.

Seed Treatment

Treat seed with a combination of lindane-diazinon and captan or thiram for protection against wireworms, seed maggots and seed-borne diseases. Ready prepared seed dressings are available from the trade and should be used according to manufacturer's directions.

Seeding

Place seeds about 3.8 to 5 cm (1-½ to 2 in) deep. Space rows 60 to 96 cm (24 to 38 inches) apart according to equipment available. Space plants 30 cm (six to eight per/foot) apart in the row. Use 67 to 90 kg/ha (60 to 80 lb/acre) seed. Beans germinate best between 15° to 29°C.

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

Beans are legumes and so can have an association with nitrogen fixing bacteria which convert nitrogen from the soil air into a form the bean plant can use. These bacteria are available as pea and bean inoculants, from garden centres and seed companies. If an area has never grown beans or peas before, additions of inoculants are recommended. Heavy applications of manure or fertilizers high in nitrogen may induce a large amount of vine or leaf growth and frequently delay pod maturity and reduce yield.

As a general application, apply 20 to 60 kg/ha (18 to 54 lb/acre) of nitrogen and broadcast and incorporate

120 to 160 kg/ha (107 to 143 lb/acre) of phosphate (P_2O_5). The amount of nitrogen required will be less in soils where beans have been grown before and there are sufficient soil organisms established that can fix nitrogen in the soil. Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 35 to 70 kg/ha (31 to 62 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of **sulphate** sulphur fertilizer, see page 15.

Irrigation

Moisture requirements are most critical from the bud stage to harvest. The crop requires 2.5 to 3.8 cm (1 to 1·½ inches)/week during this period for maximum yields.

Weed Control

Stale Seedbed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated

Eptam 8-E 800 g/L, Eptam 10G (10%) Snap beans only. Controls annual grasses and several broadleaf weeds. (Table 1) Spring application only. Apply 4.25 to 5.5 L/ha or 34 to 45 kg/ha product. Apply liquid in at least 100 L/ha water. The granular product should be applied with a suitable granular applicator. Eptam must be applied to a dry soil surface of a well prepared seedbed. Incorporate immediately according to instructions on product label or *1986 Guide to Chemical Weed Control.*

Caution: The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane or Eptam or Sutan + the previous growing season. It is anticipated that the reduction in control will be greater where Eradicane, Eptam or Sutan + has been used repeatedly for two or more years.

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail and several broadleaf weeds. For snap beans apply 1.6 to 2.8 L/ha of Rival or 1.5 to 2.0 L/ha of Treflan EC as a spring preplant application in at least 45 L/acre water. For lima beans, apply 1.6 to 2.0 L/ha of Rival or 1.0 to 1.5 L/ha of Treflan EC. See product label or *1986 Guide to Chemical Weed Control* for specific application instructions.

Preemergence

Sinox PE (360 g/L) Controls several broadleaf weeds (Table 1). Apply Sinox PE on snap beans only, at 17 to 22 L/ha in 250 to 400 L/ha water at time of or shortly after planting. Do not apply these products on light sandy soil containing little or no organic matter.

Caution: Use rubber gloves, goggles, and agricultural respirator when handling Sinox PE or Yellow Stuff PE.

Postemergence

Basagran (480 g/L) Controls several annual broadleaf weeds. (Table 1). Apply 1.75 to 2.25 L/ha in 200 to 400 L/ha water after first trifoliate leaf stage. The addition of Citowett Plus at 2.5 L/1000 L of spray mixture or Assist Oil Concentrate at 5 to 10 L/1000 L of spray mixture will improve weed control.

Control Canada thistle and field bindweed with split application of 1.75 L/ha plus 1.75 L/ha applied seven to ten days later in 200 to 400 L/ha water. For Canada thistle control only, add Citowett Plus at 2.5 L/1000 litres of spray mixture or Assist Oil Concentrate at 5 to 10 L/1000 litres of spray mixture when thistles are in bud stage, 15 to 20 centimeters tall. Apply when field bindweed has developed a dark green colour and before it has begun trailing.

Sinox PE (360 g/L) Controls several broadleaf weeds (Table 1). Apply Sinox PE on snap beans only, at 8.0 to 14 L/ha in 250 to 400 L/ha water when beans are in, but not beyond the crook stage. Do not use these products on light sandy soil containing little or no organic matter.

Apply when crop foliage is dry. Leaf burn may occur, but this is usually not harmful. Spraying is more effective and less product is required at moderately high temperatures of 21° to 30°C. However, to avoid crop damage, do not spray when temperatures exceed 30°C or is expected to exceed 30° within 24 hours after application. Below 21°C use the higher rates. Since these products act by contact action only, ensure that the spraying system gives uniform coverage of all weed foliage.

Caution: Use rubber gloves, goggles, and agricultural respirator when handling Sinox PE.

Disease Control

Anthracnose and Bacterial Blights These casual organisms overwinter in seed and plant debris.

To control:

- use only disease free seed grown in an area free from these two diseases,
- practice a three year crop rotation, and
- do not work in crop when it is wet,
- apply tribasic copper sulphate (Tri cop) or cupric hydroxide (Kocide 101) at 1.1 to 3.3 kg/ha (1.00 to 3.00 lb/acre) at first sign of disease. Do not apply within one day of harvest. Chemical control may not be practical except for small seed plots or other special situations.

Seed Decay, Damp Off Treat seed with Captan, Dexon, or thiram.

White Mold (Sclerotinia), Gray Mold (Botrytis) Apply benomyl (Benlate) at 1.75-2.25 kg/ha (36-40 oz/acre) or iprodione (Rovral) at 1.5 kg/ha (1.4 lb/acre) between 50% and full bloom with enough water to obtain thorough coverage. Under severe disease conditions use the high rate. Rotate with resistant or immune crops (ie. beets, onions, spinach, corn, cereals or grasses) for 3

years before planting other susceptible crops such as carrots, lettuce, parsnips, cucurbits or celery.

Crop Rotation Three years between bean crops. Avoid other susceptible crops such as carrots, lettuce, parsnips, cucurbits, crucifers and sunflowers. Rotate with non-susceptible crops such as beets, onions, corn and cereals.

Fusarium and Other Soil-Borne Root Rots Treat seed with captan or thiram seed protectants. Avoid poorly drained soil and practice a crop rotation of at least three years.

Insect Control

Seed Maggots, Wireworms and Seed Decay Treat with a combination of diazinon, lindane and thiram or captan.

Leaf Hoppers 1) apply Sevin 80S at 2.2 kg/ha (2.00 lb/acre); 2) or apply Thiodan 4E at 2.1 L/ha (30 fluid ounces/acre); 3) or apply malathion 50EC at 2.2 L/ha (32 fluid ounces/acre).

Beets (Red)

Varieties

Round Early wonder (bunching); King Red; Ruby Queen; Detroit Dark Red; Vermilion; Spring Red.

Cylindrical Formanova.

Seed Treatment

Seed should be treated with thiram or captan before seeding. Apply according to manufacturer's directions.

Transplants

For early beets, sow seed in greenhouse six weeks prior to planting in the field. Seedlings should be placed approximately 7.6 cm (3 inches) apart in rows 30 to 40 cm (12 to 16 inches) apart when transplanted in the field. Care should be taken not to break the tap root.

Seeding

Sowing at two week intervals will provide a continuous supply for summer markets. Beets for storage should be sown about 10 weeks before normal harvest date.

Optimum germination temperature is 4° to 29°C. Seed should be placed 1 to 2 cm (one half to three quarter inch) deep. About 3 kg (6.00 lb) seed will plant an acre when seeded in rows 40 cm (16 inches) apart. Thin plants 5 to 8 cm (2 to 3 inches) apart.

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

As a general recommendation, apply 40 to 70 kg/ha (36 to 62 lb/acre) nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) P_2O_5. Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/ acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Trace Elements To prevent internal black spots, apply 22 kg/ha (20 lb/acre) borax along with the fertilizer or spray with a foliar spray at 4.4 kg/ha (4.00 lb/acre).

Weed Control

Stale Seedbeed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated

Ro-Neet 7.2 E (720 g/L) Controls annual grasses and several broadleaf weeds. (Table 1) Apply 4.75 to 6.25 L/ha in 200 to 400 L/ha water. Immediately after application, thoroughly incorporate to a depth of 5 to 7 cm taking care to minimize loss of seedbed moisture.

Preemergence

Bar-fox (83%) NaTA TCA (83%) Controls green and yellow foxtail. Apply 6.75 to 10.0 kg/ha product of Bar-fox or 6.16 to 9.86 kg/ha product NaTA TCA in 100 L/ha water before emergence. Do not feed tops to livestock.

Disease Control

Seed Decay, Damp Off Treat seed with Captan, Dexon, or thiram.

Insect Control

Leaf Miners Generally, control required only for bunching beets. Spray with malathion 50 EC at 2.2 L/ha (32 fluid ounces/acre) when egg masses are noticed on the underside of the leaves, or spray with diazinon 50 EC at 3.4 L/ha (48 fluid ounces/acre).

Tarnished Plant Bug Spray with dimethoate 2E at 1.4 L/ha (20 fluid ounces/acre).

Sprout Inhibition

Apply maleic hydrazide (Royal MH 60SG) at rates recommended by the manufacturer. Apply to healthy plants which have tops in good condition 4 to 6 weeks before harvest.

Storage

Roots should be stored at 0°C and relative humidity of 95%. Tap root should not be removed.

Cabbage, Cauliflower, Brussel Sprouts, Broccoli

Varieties

Cabbage

Early Golden Acre, Golden Cross Vela, Little Marvel, Tastie, Princess, Synargreen

Mid Season Market Topper, Market Prize, Jet Pack, Stonehead, Little Rock, Market Victor, Blue Heaven. Yellows resistant Hinova, Hitoma

Late: Summer Danish Ballhead, Autum Marvel
Winter Tripple Green, Decema Extra, Winter White III, Excel. Falcon (yellows resistant)

Red Red Acre

Chinese Michilli

Cauliflower

Early Snowball Imperial, Snowcap, Snow Crown

Mid Season Imperial 10-6, Snowball M, Snowball 25

Late Snowball Y, Suprimax

Brussel Sprouts

Jade Cross, Jade Cross E, Lancelot, Alcazar, Goldmine

Broccoli

Premium Crop, Kayak, Surfer, Southern Comet, Green Comet, Cruiser.

Seed Treatment

Treat Seed with thiram or captan before seeding and apply according to manufacturer's directions.

Seeding

About 280 g/ha (4 ounces/acre) seed provides sufficient transplants for the land. For direct seeding, use 2.2 kg/ha (2.00 lb/acre) and thin to the desired population. Direct seeded crops should be sown 12 to 19 mm (one half to three quarter inch) deep.

Spacing

Cabbage

Early crop transplants are set in the field in early May. Late cabbage is seeded directly about a week later (May 10 to 15).

Early Rows 76 cm (2-½ feet) apart, plants 38 to 45 cm (15 to 18 inches).

Mid Season Rows 76 to 90 cm (2-½ to 3 feet) apart, plants 38 to 45 cm (15 to 18 inches).

Late Rows 76 to 90 cm (2-½ to 3 feet) apart, plants 45 to 60 cm (18 to 24 inches).

Cauliflower

Normally set out into the field as transplants after the danger of frost is over. Mid season and late crops are direct seeded.

Rows 76 cm (2-½ feet) apart, plants 45 to 60 cm (18 to 24 inches).

Brussel Sprouts

Grown only from transplants which are set out into field about May 20-25 and require the entire season to mature.

Rows 90 cm (3 feet) apart, plant spacing 53 cm (21 inches).

Broccoli

Grown from transplants or seed. Early crops are set out as transplants, while late crops are direct seeded.

Rows 60 cm (2 feet) apart, plants 10 to 15 cm (4 to 6 inches).

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

For a general recommendtion apply 60 to 100 kg/ha (54 to 89 lb/acre) of nitrogen and broadcast and incorporate 150 to 180 kg/ha (133 to 160 lb/acre) of phosphate (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 170 to 200 kg/ha (152 to 178 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Transplants As cole crops respond favourably to liberal application of nitrogen and phosphorus, use of a starter solution such as 20-20-20 is recommended. Mix at the rate of 454 g/45 L (1 lb/10 gal) of water and apply 284 mL (10 ounces) per plant.

Note: *If necessary, additional nitrogen at the rate of 28 to 39 kg/ha (25 to 35 lbs/acre) may be applied between the rows or applied through the irrigation system about a month after seeding or transplanting.*

Boron If the soils are known to be deficient in boron, apply 22 kg/ha (20 lb/acre) borax. It may be broadcast over the field and disced in before planting. If a foliar spray is used during the growing season, reduce the rate to 4.5 kg/ha (4.00 lb/acre) borax.

Weed Control

Stale Seedbed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail and several broadleaf weeds. For spring application only. Apply 1.6 to 2.8 L/ha of Rival

or 1.5 to 2.0 L/ha of Treflan EC in at least 100 L/ha water. See product label or *1986 Guide to Chemical Weed Control* for specific application instructions.

Disease Control

Clubroot is an occasional problem in Manitoba but may become more frequent in occurrence if crop rotation is not followed. Follow a four year crop rotation and avoid all cruciferous crops including canola (rapeseed) and mustard in the same rotation. Thoroughly clean all planting and harvesting equipment between fields. Use a presurized washer and follow with a disinfectant.

Damping Off, Wirestem Delay planting as long as possible to avoid cold, moist soils which favor disease development. Grow transplants in fumigated soil. Space seedlings in seed beds to allow air circulation around the plants. Dust seed with captan or thiram before planting.

Downy Mildew Broccoli and cauliflower heads. Avoid overwatering particularly in the late afternoon. Apply Bravo 500 at 2.5-4.8 L/ha (38-72 oz/acre) or Zineb 75 WP or Dithane Z78 at 2.25 kg/ha (2 lb/acre) in 1100 L/ha (100 gal/acre) on a 7-10 day schedule. Do not apply within 7 days of harvest. Incorporate crop remains as soon as harvest is complete, to ensure early breakdown of crop residue.

Bacterial Soft Rot and Watery Soft Rot (Sclerotinia) Avoid injury to plants in cultivation or at harvest; use plant spacing that allows for good air circulation; control root maggots, slugs and other chewing insects. Disinfect storage bin with two per cent copper sulphate solution or other disinfectant before storing the crop. Follow a three year crop rotation and avoid other crucifers, beans, lettuce, carrots and celery. Rotate with cereals, corn, onions, beets.

Blackleg, Black Rot Sow hot water treated seed 50°C for 25 minutes for cabbage and brussels sprouts and 15 minutes for cauliflower or broccoli. Avoid working in field when plants are wet. Follow a three year crop rotation.

Brown Heart (Boron Deficiency) See fertilizer.

Fusarium Yellows Fusarium yellows is an occasional problem in Manitoba but once the disease is established in a field it can cause complete crop loss of susceptible cabbage varieties. Long rotations of three or more years are required to reduce the incidence of Fusarium fungus in the soil. There are varieties available that have good resistance to Fusarium yellows and these are presently being evaluated in Manitoba.

Insect Control

Root Maggots Apply Birlane granules at 550 grams/300 m (20 ounces/1000 ft) row or apply Dasanit granules at 1,160 grams/1000 m (13.3 ounces/1000 feet) row. Work granules into top 2.5 cm (1 inch) soil in 15 cm (6 inches) band and seed into band.

Cabbage Worm, Cabbage Looper, Diamond-Back Moth Larvae Spray with diazinon 50EC at 1.1 L/ha (16 fluid ounces/acre); Monitor at 1.1 to 2.4 kg/ha (16 to 33 fluid ounces/acre); Lannate L at 1.25 to 2.5 L/ha (17 to 33 fluid ounces); Thiodan 4E at 1.4 to 2.8 L/ha (20 to 40 fluid ounces/acre); Belmark at 160 to 330 mL/ha (2.3 to 4.7 fluid ounces/acre); Ambush 70-140 mL/ha (1 to 2 fluid ounces/acre), Decis 5.0 EC at 150 to 200 mL/ha (2 to 3.5 fluid ounces/acre) or with Bacillus thuringiensis according to label directions. Dust with rotenone at 22 kg/ha (20 lb/acre) 1 per cent dust.

Aphids Spray with either Malathion 50EC at 1.1 to 2.8 L/ha (16 to 40 fluid ounces/acre), or Thiodan 4E at 2.1 L/ha (30 fluid ounces/acre), or Dimethoate (Cygon 4E) at 0.7 to 1.4 L/ha (10 to 20 fluid ounces/acre), or Monitor at 1.1 to 2.3 L/ha (16 to 33 fluid ounces/acre), Ambush at 75 to 150 mL/ha (1.2 to 2.3 fl. oz/acre).

Flea Beetles Watch carefully for flea beetles as small plants emerge from the soil. Spray plants every five to seven days until plants become well established. Use Malathion 50EC at 1.1 L/ha (16 fluid ounces/acre) or Thiodan 4E at 1.5 to 3.0 L/ha (20-40 fluid ounces/acre), or Sevin 80S at 0.7 to 1.5 kg/ha (10-20 ounces/acre).

Slugs See slugs under Celery and refer to General Pesticide Recommendations section.

Special Problems

Cabbage Splitting Well developed heads may split if heavy rains follow a prolonged dry spell. The splitting is caused by rapid growth promoted by improved growing conditions. Maintaining uniform growth with proper irrigation may partially prevent this.

Cauliflower Buttoning This is identified by the formation of a small head before the plant is mature enough to support it. It causes the head to remain small and unmarketable. It may be the result of:

1. Overhardening of the young plants.
2. Unbalanced soil fertility.
3. Too low moisture supply.
4. Extreme and cold weather 4° to 10°C for 10 days or more especially under conditions of excess soil moisture.

An application of 45.5 kg/ha (100 lb/acre) of 34-0-0 through the irrigation system may assist in rectifying the problem. Application should be made as soon as possible after stress conditions occur.

Harvest and Storage

Cabbage and Brussel Sprouts Cabbage heads are harvested after the heads have become firm. Brussel Sprouts are harvested when sprouts are 2.5 to 5 cm (1 to 2 inches) diameter. Sprouts are best stored on the stock for longer storage life. Sprout development is improved and made more uniform by pinching the growing point of the plants when the middle sprouts are about 12 to 19 mm (one half to three quarters inch) in diameter. Both crops store well at a temperature of 0°C and a relative humidity of 100 per cent. To retain the rich green color, field heat must be removed immediately after entering storage. Most green coloring will disappear unless the temperature is reduced within the first week of storage.

Cauliflower Harvest heads when they are 15 cm (6 inches) or more in diameter and before the curd begins to separate and "rice". Tying up the leaves to enclose the head is usually necessary to produce a bright white curd.

Broccoli Heads should be harvested when the flower bud clusters are well formed but before yellow flowers appear. The terminal bud is the largest and forms first, followed by the laterals. Broccoli should be trimmed to about 15 cm (6 inches).

Cauliflower and broccoli will store for short periods of time if the field heat is removed immediately after harvest. For broccoli, storage quality is maintained at a much higher level if the product is covered with a layer of crushed ice (slush) after it is packed in the container ready for shipment. This helps prevent dehydration while it is moving through the distributive trade.

Carrots

Varieties

Fresh Market Six Pak, Hipack (main crop), Sierra, Figaro, Flakkeese Flacoro.

Processing Sparton Bonus, All Season Cross, Royal Cross

Seeding

Seedbed Preparation Deep fall plowing 20 to 35 cm (8 to 10 inches) followed by spring operation that will leave a fine seedbed for uniform germination. Prepare land in three to four row beds to prevent compacted tire tracks in growing area.

Rates Optimum stand of carrots is 10 to 16 carrots per 30 cm (foot) of row. This is usually obtained in Nantes types by using hole 7 or 8 on Planet Jr. seeder. Increase seeding rate slightly for Imperator types. The ground speed of seeder will affect seeding rate if Planet Jr. seeder is used.

Row Spacing 40 to 50 cm (16 to 20 inches)

Depth 2 to 2.5 cm (three quarter to one inch) is most satisfactory. Since the seed is very small at no time should it be planted more than 2.5 cm (1 inch) deep.

Dates	Early crop	May 10 to 15
	Storage crop	May 24 to 31

Irrigation

The carrot is not tolerant to drought or high temperatures. It needs steady and relatively large amounts of water for optimum growth. If high temperature conditions exist when seedlings are just emerging, irrigation will prevent serious damage to the young plants. Irrigation can be used very effectively to overcome heavy soil crusting that can reduce the stand if not removed.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

Carrots have shown little response to chemical fertilizer in Manitoba except when grown on relatively light soils low in nutrients. Where soil fertility is low (according to soil tests) apply nutrients according to guideline tables 5, 6, 7 and 8.

Weed Control

Stale Seedbed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail and several broadleaf weeds. For spring application only. Apply 1.6 to 2.8 L/ha of Rival or 1.5 to 2.0 L/ha of Treflan EC in at least 100 L/ha water. See product label or the *1986 Guide to Chemical Weed Control* for specific application instructions.

Postemergence

Afolan F (450 g/L), Lorox L (480 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply Afolan F at 1.9 to 5L/ha or Lorox L at 2.25 to 4.5 L/ha in 220 to 330 L/ha water.

Do not apply with greater than 275 kPa pressure. Spray when carrots have two or more fully developed leaves. Use lower rates on small seedling weeds and higher rates on larger established weeds. Apply before annual grasses exceed 5 cm in height or before broadleaf weeds exceed 15 cm. During hot, dry weather spray in the cool part of the day to avoid injury.

Agricultural Weedkiller No. 1 (100%) Controls barnyard grass and several broadleaf weeds. (Table 1) Apply 600 to 900 L/ha as an overall treatment when carrots are in the two to four leaf stage and before weeds are 10 cm tall. **Spray in evening when humidity is high and winds are light.**

Caution: Do not mix Agricultural Weedkiller No. 1 with other herbicides.

1. If Afolan F or Lorox L is applied first, wait 24 hours before applying Agricultural Weedkiller No. 1

2. If Agricultural Weedkiller No. 1 is applied first, wait at least two weeks before applying Afolan F or Lorox L.

Hoe Grass 284 (284 g/L) Controls certain annual grasses (Table 1). Apply 3.5 L/ha product in at least 112.3 L/ha water when weeds are in one to four leaf stage. Consult label for correct application procedure.

Lorox L See Afolan F

Disease Control

Aster Yellows Control leafhoppers that spread the mycoplasma (see insect control). Avoid growing carrots near forage legumes or other areas where leafhopper populations are high.

Leaf Spots and Blights Spray every 7 to 14 days depending on weather conditions with one of the following fungicides: maneb (Manzate D, Dithane M-33) 3.4 kg/ha (3.00 lb/acre); mancozeb (Dithane M-45, Manzate 200) 2.2 kg/ha (2.00 lb/acre); metiram (Polyram 80W) 2.2 kg/ha (2.00 lb/acre); zineb (Dithane Z-78) 3.4 kg/ha (3.00 lb/acre); chlorothalonil (Bravo 500) 1.6-2.4 L/ha (24-36 oz/acre). Refer to page 8 "Residue Tolerances and Days to Harvest."

Bacterial Soft Rot and Watery Soft Rot (Sclerotinia) Handle the crop carefully to avoid wounds. Cull during harvest if rots are present. Disinfect storage area before storage using a 2 per cent solution of copper sulphate (for example, 1kg/50 L water or 2.00 lb/10 gallons water). Allow storage area to dry before storing carrots. Follow a crop rotation of three years between successive crops. Rotate with onions, beets, cereals or corn. Avoid beans, lettuce, parsnips, cole crops including canola (rapeseed), peas, lentils, cucumber and celery since all are susceptible to Sclerotinia. For a listing of field crops susceptible to sclerotinia disease consult *The 1986 Field Crop Production Recommendations* for Manitoba. Carrots harvested during warm weather should be cooled as quickly as possible. Spray or dip washed or unwashed carrots either before or after storage period with benomyl (Benlate 50 WP) at .5 - 1.0 kg/1000 L (.45 - .90 lb/100 gallons) of water. Do not treat carrots for export with Benlate 50WP Under Manitoba conditions, Benlate treatment of unwashed carrots may result in reduced control.

Insect Control

Leafhoppers Apply Sevin XLR at 1.25 to 2.5 L/ha (18 to 36 fluid ounces/acre) or Malathion 50 EC at 1 - 3 L/ha (15 - 45 fluid ounces/acre) twice weekly or Furadan 10G at 22.4 kg/ha (20 lb/acre) at planting time. Apply in seed furrow 1.3 cm (one half inch) below the seed. Additional sprays late in July and during August of other insecticides (Sevin, malathion) are required for maximum control.

Sprout Inhibition

Apply maleic hydrazide (Royal MH 60SG) at rates recommended by the manufacturer. Apply to healthy plants which have tops in good condition 4 to 6 weeks before harvest.

Special Problems

Greening Constant hilling throughout the growing season is essential to prevent green shouldered carrots.

Off-Shape Roots These may be caused by:

- lack of stand
- poorly prepared seedbed
- excess moisture at certain periods
- excessive packing of soil by equipment

Browning Caused mainly from excessive drying of roots following harvest such as:

- harvesting in excessive heat
- neglecting to remove carrots from field immediately after harvest
- lack of cooling facilities in storage
- excessive drying in storage through lack of humidity controls

Preventive Measures

- Harvest under cool conditions when possible.
- Prevent drying from field to storage.
- Remove field heat rapidly after carrots have entered storage.
- Maintain humidity of storage at 100 per cent and temperature at 0°C.
- Soaking pile periodically after carrots are in storage helps prevent drying and aids in removing field heat. However, this practice may favor development of Sclerotinia soft rot in stored carrots.

Celery

Varieties

Utah 52-70

Seed Treatment

Purchase hot water treated seed or use three year old seed to avoid seed-borne blight disease. Treat seed with a fungicide such as thiram (according to directions on label) before planting in flats. Seed germination is normally slow and often takes up to 20 days from seeding.

Transplants

Allow 10 to 12 weeks to produce plants for field planting. As a rule of thumb, 210 g of seed produces sufficient transplants for 1 hectare (3 ounces for 1 acre). The general practice has been to plant celery at 30 x 30 cm (12 x 12 inch) spacing.

A starter solution such as 20-20-20 is recommended. Mix 454 g (1.00 lb) fertilizer/45 L (10 gal) water and apply 280 to 300 mL (one-half pint) per plant.

Temperatures of 21° to 24°C are quite suitable for germination. The regular growing temperature should be held at 18° to 21°C. If plants are subjected to temperatures of 2° to 10°C "bolting to seed" occurs. The amount of bolting increases as the exposure period is lengthened. Thus, plants should not be set in the field until the danger of a prolonged cool period is over, and may be hardened if desired by withholding water the last 7 to 10 days before setting in the field. Do not harden off plants by lowering the temperature. Clip the tops once or twice while the plants are in the flats to develop sturdier seedlings.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

For a general recommendation apply 120 to 160 kg/ha (107 to 143 lb/acre) of nitrogen. Broadcast and incorporate 150 to 180 kg/ha (134 to 161 lb/acre) of phosphate (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 170 to 200 kg/ha (152 to 178 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅙ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

If cracked stems have been a problem, boron should be added as borax at 17kg/ha (15 lb/acre). If spraying borax over the crop, reduce the rate to 4.5 kg/ha (4.00 lb/acre).

Weed Control

Postemergent to weeds, 8 to 10 days after transplanting and new growth has started.

Afolan F (450 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply 1.9 to 5 L/ha in 220 to 330 L/ha water. Do not apply under hot conditions.

Disease Control

Early and Late Blight Use disease free seed or seed more than two years old or seed that has been hot water treated at 48°C for 30 minutes. Follow a regular spray program commencing about July 15. Apply sprays every 7 to 10 days unless there is a prolonged period of dry weather. Fungicides found effective against blight include Chlorothalonil (Bravo 500) at 2.4 to 4.0 L/ha (36 to 60 oz/acre) (do not apply within seven days of harvest).

Anilazine (Dyrene 50 WP) at 2.25 to 3.5 kg/ha (2 to 3 lb/acre). Wash and trim before packing if last application was made less than seven days before harvest. Refer to ***Residue Tolerances and Days to Harvest*** page 8.

This disease can become very severe under wet conditions late in the season.

Black Heart (Physiological) Maintain uniform soil moisture in the field. Avoid excess application of fertilizer. Apply calcium nitrate at 1.0 to 2.0 kg/ha (0.90 - 1.8 lb/acre) or calcium chloride at 0.50 to 1.0 kg/ha (0.45 - 0.90 lb/acre) in 454.6 L (100 gal.) water every 7 to 10 days during periods when disease threatens, especially during cloudy warm weather.

Aster Yellows Control the leafhopper which spreads the mycoplasma. Refer to the Insect Control Section. Avoid growing celery near forage legumes or other areas where leafhopper populations are high.

Insect Control

Leafhoppers Spray or dust every seven days with Sevin 80S at 1.4 kg/ha (20 oz./acre) or malathion 50 EC at 2.2 L/ha (32 fl. oz./acre).

Tarnished Plant Bug Spray or dust with Thiodan 4E at 2.1 L/ha (30 fluid ounces/acre).

Aphids Spray with malathion 50 EC when required at 2.0 L/ha (30 fluid ounces/ac) or thiodan 4E at 2.1 L/ha (30 fluid ounces/acre).

Slugs Apply a directed spray of metaldehyde between the plant rows early in June. Repeat as required. Do not apply spray to edible portions of plants. Do not spray within 14 days of harvest.

Metaldehyde may also be purchased in the granular form. This material may be applied as a band between the rows. Apply according to directions on the label. Refer to ***General Pesticide Recommendations*** on page 11.

Harvest and Storage

Celery is cut 2.5 to 5.0 cm (1 to 2 inches) below the crown. Trim the coarse outer leaves. Prior to storage, the field heat should be removed through hydro-cooling. Celery will last up to two months in storage with a minimum of loss if held at 0°C and a relative humidity of 95 per cent.

Corn (Sweet)

Varieties

Early Earlivee, Dawn, Beacon, Early Arctic, Northlite, Queen Anne, Seneca Horizon

Main Crop Golden Beauty, Yukon, NK51036, Sunny Vee, Ont. Hyb. 8011 and 814, Jubilee, Early Golden, Tokay Sugar (white)

Late NK199, Honeycomb, Flavorvee, Sugar Loaf, Candy Bar, Bullseye, Golden Nectar

White Snowcap, White Lightning, Stardust

Seeding

Soil temperature should be above 13°C for rapid and vigorous germination.

Date May 15 approximately

Rate 11 to 13 kg/ha (10 to 12 lb/acre)

Spacing Rows 76 to 95 cm (30 to 42 inches) apart (depending on machinery for cultivation). Plant 20 to 25 cm (8 to 10 inches) apart in the row for early varieties and 25 to 32 cm (10 to 12 inches) for main crop varieties.

Fertilizer

For specific recommendations, have your soil tested. Sample at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

All nitrogen, phosphate and potash should be banded at time of seeding, if possible. The total amount of fertilizer material side-banded should not exceed 340 kg/ha (303 lb/acre). Nitrogen requirements not side-banded at time of seeding should be side-dressed before the corn is 15 cm (6 inches) high.

GENERAL RATE OF NUTRIENT TO ADD

Corn to be grown on	Nitrogen (N)[1] kg/ha	Nitrogen (N)[1] lbs/acre	Phosphate (P_2O_5) kg/ha	Phosphate (P_2O_5) lbs/acre	Potash (K_2O) kg/ha	Potash (K_2O) lbs/acre	Sulphur (S) kg/ha	Sulphur (S) lbs/acre
Fallow or legume breaking (2)	0-30	0-27	30-45	27-40	(3)	(3)	(4)	(4)
Grass and grass-legume breaking (2)	30-75	27-67	30-45	27-40	(3)	(3)	(4)	(4)
Stubble	75-150	67-134	30-45	27-40	(3)	(3)	(4)	(4)

(1) Rates are based on granular nitrogen applied broadcast at or near seeding time. See section Relative Efficiencies of Time and Method of Application, page 14.

(2) Refers to breaking after first cut of forage.

(3) Sands, sandy loam and organic soils are frequently low in available potassium. On these soils apply 30 to 110 kg/ha, (27 to 98 lb/acre) of potash (K_2O).

(4) Twenty kg/ha (18 lb/acre) of **sulphate** sulphur (S) are recommended on well-drained sandy soils. For information on the application of different forms of **sulphate** sulphur fertilizer see Page 15.

Excess nutrient levels may occur when high rates of fertilizer are used on continuous corn. Soil testing to a depth of 60 cm (24 inches) is strongly recommended to monitor nutrient levels and avoid over-fertilization.

To determine the possible cause of poor growth due to nutrient deficiencies, see pages 20 and 21 of the publication, *Field Corn in Manitoba*, and contact your local agronomist.

Weed Control

Stale Seedbed

Refer to Weed Control — Stale Seedbed on page 11.

Preplant Incorporated

Dual (960 g/L) Controls green and yellow foxtail and barnyard grass. Apply 2 to 2.75 L/ha in a minimum of 150 L/ha water. Use higher rate for heavy weed infestations. Incorporate in the top 5 cm of soil with a tandem disc, vibrating shank cultivator or harrows set to work the soil no deeper than 10 cm. Immediate incorporation is not required. Do not use on peat or muck soils. Heavy rainfall conditions following application of Dual may result in reduced weed control, especially on sandier soil types. Dual may be tank mixed with Aatrex or Atrazine. See product label or *1986 Guide to Chemical Weed Control* for incorporation instructions.

Eradicane 8-E (800 g/L) Controls several grasses and broadleaf weeds. (Table 1) Earlivee, Golden Beauty, Golden Jubilee, M-71112, M-71276, NK 51036, NK 199, North Star, Reliance (NK 2580), Span Cross, Sunnyvee and Yukon are tolerant varieties. Apply at 4.25 to 5.5 L/ha in at least 100 L/ha water to the dry soil surface of a well prepared seedbed. Spray and incorporate immediately. Plant seed to a maximum depth of 5 cm. See product label or *1986 Guide to Chemical Weed Control* for information on incorporation and rates required.

Caution: The level of weed control will be reduced where Eradicane is used on soils which have been treated with Eradicane or Eptam or Sutan + the previous growing season. It is anticipated that the reduction in control will be greater where Eradicane, Eptam or Sutan + has been used repeatedly for two or more years.

Lasso (480 g/L) Lasso was available for use in sweet corn under a temporary registration granted by Agriculture Canada in 1985. At the time of printing, this registration was under review due to health concerns. For revised information concerning availability, application instructions, safety considerations and use precautions, see the 1986 Addendum to the *1986 Guide to Chemical Weed Control* or consult your agricultural representative, weed supervisor or Monsanto representative.

Primextra (500 g/L) Controls green and yellow foxtail, barnyard grass and several broadleaf weeds. (Table 1) Apply 6.7 to 8.5 L/ha in a minimum of 150 L/ha water. Use the higher rate when heavy weed infestations are expected. Incorporate thoroughly into the top 5 cm of soil prior to planting. Immediate incorporation is not necessary. Heavy rainfall conditions following application of Primextra may result in reduced weed control, especially on sandier soil types. See product label or *1986 Guide to Chemical Weed Control* for incorporation instructions. This treatment may leave a residue in the soil the following year. See caution under Sutan+ and Atrazine.

Sutan+ (800 g/L) Controls green and yellow foxtail and barnyard grass. Apply 4.25 to 5.5 L/ha in a minimum of 100 L/ha water to a dry soil surface of a well prepared seedbed. Spray and incorporate immediately. Do not seed deeper than 5 cm. See product label or *1986 Guide to Chemical Weed Control* for incorporation instructions. Follow Sutan+ application with a recommended postemergence herbicide to control broadleaf weeds if necessary.

Caution: The level of weed control will be reduced where Sutan+ is used on soils which have been treated with Eradicane, Eptam or Sutan+ the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Postemergence

For corn less than 15 cm tall (leaf outstretched) the following treatments may be applied as an overall spray.

Basagran (480 g/L) Controls several broadleaf weeds. (Table 1) Apply 1.75 to 2 L/ha in 200 to 400 L/ha water. Use the lower rate to control lady's thumb and annual smartweed species 2.5 to 7.5 cm high, wild mustard 2.5 to 12.5 cm high or cocklebur 7.5 to 17.5 cm high. Use the higher rate to control lady's thumb and annual smartweed species 7.5 to 20 cm high, wild mustard 12.5 to 25 cm high, cocklebur 17.5 to 30 cm high, and seedlings of other susceptible weeds. The addition of Citowett Plus at 2.5 L/1000 litres of spray mixture or Assist Oil Concentrate at 5 to 10 litres/1000 litres of spray mixture will improve the control of advanced weeds.

Basagran also controls top growth of Canada thistle and field bindweed (patch treatment). Apply a split application of 1.75 L/ha plus 1.75 L/ha seven to ten days later. Apply in 200 to 400 L/ha water, when thistles are in the bud stage, 15 to 20 cm tall and when field bindweed has developed a dark green color and before it has begun trailing. Add Citowett Plus at 2.5 L/1000 litres spray mixture or Assist Oil Concentrate at 5 to 10 L/1000 litres of spray mixture to improve control. Best results are obtained when Basagran is applied under higher temperatures 21°C.

Buctril M (560 g/L) Controls several broadleaf weeds. (Table 1) Apply 1.00 L/ha in 200 to 300 L water at a pressure of 275 kPa when corn is in the 4 to 6 leaf stage and weed seedlings are small. Leaf scorch may occur if application is made under hot, humid conditions.

Kil-mor (500 g/L) Controls several broadleaf weeds. (Table 1) Apply 0.85 to 1.1 L/ha in 100 litres/ha water as an overall spray. For corn over 15 cm tall see postemergence recommendation in this section.

2,4-D amine Controls several broadleaf weeds. (Table 1) Apply 840 to 1120 mL/ha of formulations containing 500 g/L 2,4-D amine in 100 L water as an overall spray until corn is 15 cm tall (leaf outstretched), after which a directed spray should be used. See directed postemergence recommendations in this section for product volumes of other formulations of 2,4-D amine see the *1986 Guide to Chemical Weed Control.*

For corn over 15 cm tall the following treatments may be applied as an overall spray.

Pardner (280 g/L) Controls several broadleaf weeds. (Table 1) Apply 1.0 to 1.2 L/ha in at least 200 L/ha water. Apply when corn is in the four to eight leaf stage and before the weeds are past the four leaf stage. Do not use under conditions of high humidity and high temperature (greater than 30°C) or crop injury may occur.

Caution: Pardner is available at two different strengths. Consult the product label to confirm that correct rates have been chosen for the product concentration being used.

Torch DS (450 g/L) Controls several broadleaf weeds. (Table 1) Apply 625 to 875 mL/ha of Torch DS in at least 159 L/ha water. Apply before weeds are past the four leaf stage and before the corn is 25 cm high. Do not apply under conditions of high humidity and high temperature (greater than 30°C) or crop injury may occur.

Directed Postemergence

For corn over 15 cm tall (leaf outstretched). Application of these herbicides requires positioning of the nozzles to direct spray to the base of the corn plant. Severe damage is likely if the crop leaves are sprayed.

Kil-mor (500 g/L) Controls several broadleaf weeds. (Table 1). Apply 0.85 to 1.1 L/ha in a minimum of 100 L/ha water.

2,4-D amine Controls several broadleaf weeds. (Table 1) Apply 1.7 L/ha of formulations containing 500 g/L 2,4-D amine in 100 to 200 L/ha water according to the species and stage of weeds present. For product volumes of other formulations of 2,4-D amine, see the *1986 Guide to Chemical Weed Control.*

Insect Control

European Corn Borer Apply two or more sprays at seven day intervals beginning approximately July 15. Spray with Sevin XLR at 2.5 to 4L/ha (45 to 55 fluid ounces/acre) or Lannate L at 2.6 L/ha (37 fluid ounces/acre) or Furadan 4.8F at 1.1 L/ha (16 fluid ounces/acre) or Ambush 500 EC at 200 to 275 mL/ha (2.9 to 3.9 fluid ounces/acre).

Corn Earworm Spray with Sevin XLR at 2.5 to 4L/ha (45 to 55 fluid ounces/acre) or Lannate L at 2.6 L/ha (37 fluid ounces/acre) or Furadan 4.8F at 1.1 L/ha (16 fluid ounces/acre) or Thiodan 50 WP at 2.2 to 3.4 kg/ha (2 to 3 lb/acre) or Ambush 500 EC at 200 to 275 mL/ha (2.9 to 3.9 fluid ounces/acre).

Bee Warning

Bees often visit sweet and field corn to collect pollen. While spraying is being done, bee poisoning may result.

Sevin, Furadan and Ambush are highly toxic to bees but Sevin is the most damaging since it is carried to the hive and poisons the brood.

If bees are in the area advise local beekeepers of spraying activity and do not use Sevin. Your local agricultural representative has a list of beekeepers in your area.

Bee poisoning is reduced when sprays are applied in early morning or late evening when bees are not foraging. Do not treat when the wind is blowing. Avoid spray drift to roadsides and adjacent fields where plants may be in bloom.

Disease Control

Treat seed with Captan 75 or Thiram 75 seed protectants.

Leaf Blights, Stalk Rots and Ear Rots In crop rotation, allow three years before replanting field to corn; rotate with crops other than cereals and grasses. Maintain balanced soil fertility and avoid high nitrogen imbalance.

Common Smut To prevent spread of smut cut off and destroy smut balls before they open. Follow a 2 year crop rotation.

Head Smut To prevent introduction of head smut, plant seed treated with a seed dressing containing Vitaflo 280. If disease is found in a field rotate field with special crops for two years.

Seed Decay, Damp Off Treat seed with Captan, Dexon, or thiram.

Harvesting and Storage

Sweet Corn is harvested when the kernel is fully formed but still tender. Most varieties reach this stage about the time the silk turns brown or approximately three weeks after the silks first appear. Until familiar with outward signs, test for readiness by pressing the tip kernels with your fingernail. The milky contents of the kernel should spurt out when pressure is applied.

Harvested corn must be cooled rapidly and held at below 5° C and at high humidity or it will lose quality very quickly. After harvest, sweet corn should be marketed in the shortest possible time.

Eggplant

Varieties

Black Magic, Black Bountiful

Seed Treatment

Use hot water-treated seed and dust with thiram seed protectant before planting. Apply 1 teaspoon/lb seed.

Transplants

Eggplants are a long season crop and must be started indoors. Seed is sown 8 to 10 weeks before field planting. Seeds germinate best at 26° to 29°C in sterilized soil. Care should be taken not to chill plants at any stage of development. About 280 g of seed produces transplants for 1 hectare (4 ounces for 1 acre).

Spacing Set plants 45 to 60 cm (1 ½ to 2 feet) apart in rows 81 to 91 cm (2½ to 3 feet) apart.

Irrigation

Eggplants are a rank growing crop needing ample moisture at all times.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

As a general recommendtion apply 40 to 80 kg/ha (36 to 71 lb/acre) of nitrogen. Broadcast and incorporate 150 to 180 kg/ha (134 to 161 lb/acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅛ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of **sulphate** sulphur fertilizer, see page 15.

See peppers for use of starter solution.

Weed Control

Use shallow cultivation. There are no recommended chemicals for eggplant.

Disease Control

Damping-Off Treat seed (if not already treated) with captan or thiram seed treatment.

Early Blight Use one of the following: maneb (Dithane M-22, Manzate D) 3.3 kg/ha (3 lb/acre), or zineb (Dithane Z-78) 3.3 kg/ha (3 lb/acre). Apply when first fruit clusters are well formed. Repeat at intervals of 7 to 10 days. Apply more frequently if weather is favorable to disease development. See page 9 for pre-harvest waiting period.

Verticillium Wilt Follow crop rotation of three to four years between successive crops of eggplants. Avoid tomatoes, peppers, sunflowers, alfalfa, sweet clover and potatoes which are also susceptible.

Insect Control

Flea Beetles Spray Thiodan at 1.4 L/ha (20 fluid ounces/acre) or Sevin XLR at 1.25 L/ha (20 fluid ounces/acre).

Aphids Spray malathion 50EC at 1.1 to 3 L/ha (16 to 40 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre).

Colorado Potato Beetle Spray Sevin XLR at 1.25 L/ha (20 fluid ounces/acre).

Harvesting and Storage

Fruit may be harvested at any time after reaching a sufficient size. It should be taken from the plant before the flesh becomes tough and the seeds begin to harden. The fruit is generally harvested when half grown, and used in its immature stage. Eggplant is subject to chilling if stored at temperatures below 4°C. Optimum temperatures for storage are 7° to 10°C.

Lettuce

Varieties

Leaf — Slobolt, Grand Rapids, Salad Bowl, Prizehead

Crisphead or Iceberg — Ithaca, Salinas, Highland

Butterhead — Buttercrunch, Summer Bibb

Romaine or Cos — Parris Island, Valmaine

Plant Characteristics

Lettuce is a cool weather crop and produces best at 15° to 18°C. Best results have been obtained from the

early transplant crop and the late crops grown from seed. Early May transplanting is recommended for the spring crop as plants, if properly conditioned, withstand temperatures as low as −6°C.

Planting

Transplants Start in a greenhouse 6 to 8 weeks before field planting: 280 g of seed produces sufficient transplants for 1 hectare (4 ounces for 1 acre) if sown thinly in flats. Transplant seedlings into flats at 5 cm (2 inch) spacings. Thoroughly soak flats with a starter solution of 10-52-17 before transplanting to the field.

Direct Seeding Leaf lettuce may be sown from the time the ground is ready in the spring until the latter part of August. Head lettuce of the Iceberg varieties require 8 to 10 weeks from seed and six weeks from plants. Rate of seeding is 1.6 kg to 2.2 kg/ha (1 ½ to 2 lb/per acre) seed.

Spacing Leaf and butterhead varieties 20 to 30 cm (8 to 12 inches) between plants, 30 cm (12 inches) between rows. Head lettuce 35 to 45 cm (14 to 18 inches) between plants and 40 cm (16 inches) between rows. Plants should be thinned when two or three leaves have formed.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

As a general recommendation apply 60 to 100 kg/ha (54 to 89 lb/acre) of nitrogen. Broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) phosphate (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅛ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Weed Control

There are no recommended herbicides for lettuce.

Disease Control

Aster Yellows Destroy perennial weeds around the headlands early in spring. Spray or dust the crop with malathion 50EC at 2.2 L/ha (32 fluid ounces/acre) twice weekly beginning with emergence or transplanting to control leafhoppers which carry and transmit the disease; or apply Thimet (phorate) 10% G at 11.2 kg/ha (10 lb/acre) in the fertilizer band on one or both sides of the row at seeding time, or when transplants are set in the field. Thimet is not effective for the entire crop period necessitating follow-up spray application. See label for cautions.

Physiological Breakdown Head lettuce breakdown occurs very frequently following warm rain as the crop is reaching maturity. Having the crop mature during the cooler part of the season helps prevent this condition.

Bacterial Slime Rot A bacterial rot often accompanies the physiological breakdown of lettuce heads. Avoid overcrowding and overwatering. Harvest promptly when mature and pre-cool to 10°C immediately.

Fungal Rots (Botrytis SP., Rhizoctonia Solani and Sclerotinia Sclerotiorum) Turn under crop refuse promptly after harvest. Avoid poorly drained fields and overcrowded planting. Discard heads with any trace of infection at harvest. Pre-cool to 1°C immediately after harvest. Follow a three year crop rotation avoiding beans, peas, carrots, cucumbers, squash, tomatoes and crucifers. For a list of field crops susceptible to sclerotinia disease see *The 1986 Field Crop Production Recommendations for Manitoba* published annually by Manitoba Agriculture.

Insect Control

Leaf Hoppers Spray or dust the crop with Malathion 50EC at 2.2 L/ha (32 fluid ounces/acre) or apply Thimet 10%G at 11.2 kg/ha (10 lb/acre) in the fertilizer band on one or both sides of the row at seeding time, or when transplants are set in the field. See label for cautions.

Onions

Varieties

Transplants (Spanish Types) Riverside, Bullring, Valdez, Monarch, Ringmaker, Chiefton, Winner.

***Cooking* (seeded)** Autumn Spice, Rocket, Garnet, Topaz, Bronze Age, Copper Cache, Canada Maple, Northern Oak.

Sets Ebenezer (yellow or white), Stuttgarter

Pickling Perla Prima, Aviv, Crystalwax

Bunching Perfecto Blanco, White Lisbon, He-Shi-Ko

Seeding

Date As early as land can be prepared.

Spacing Rows 35 to 45 cm (14 to 18 inches) apart depending on equipment for cultivation.

Seeding *Dry onions* 2.2 to 2.9 kg/ha (2 to 2-½ lb/acre).

Pickling 22 to 28 kg/ha (20 to 25 lb/acre).

Sets 50 to 78 kg/ha (45 to 70 lb/acre).

Depth Plant seeds 1.3 to 1.9 cm (one-half to three-quarter inch) deep.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 53 to 56 for individual recommendations based on a soil test analysis.

Dry Onions

As a general recommendation apply 40 to 80 kg/ha (36 to 71 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅛ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Sets and Pickling Onions

As a general recommenation apply 20 to 50 kg/ha (18 to 45 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅛ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Note: Apply fertilizer as a sideband application or broadcast. Burning will take place if applied directly with the seed.

Irrigation

All types of onions are very shallow rooted and quite susceptible to drought conditions. Any setback from lack of moisture may result in early maturity of bulbs with lack of size and therefore reduced yields. Maintaining satisfactory moisture level is essential for maximum yields.

Weed Control

Stale Seedbed

Refer to Weed Control — Stale Seedbed on page 11.

Preemergence

CIPC (480 g/L) plus Randox (480 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply 9.36 L/Ha CIPC plus 9.5 L/ha Randox in 220 L water. Apply before weeds germinate and before onions have reached the loop stage. Rain or irrigation of at least 1.25 cm is required immediately after application for satisfactory results. Randox is recommended for use on soils high in organic matter or clay. It is less effective on sandy soils that are low in organic matter or clay.

Note: Registration of Randox may not be continued for 1986. Consult Manitoba Agriculture regarding availability and permit requirements.

Randox (480 g/L) Controls barnyard grass, green and yellow foxtail and broadleaf weeds. (Table 1) Apply 14 L/ha immediately after planting or if heavy rain is expected just before crop emergence.

On sets or transplant onions, apply 14 L/ha as a directed spray (overall sprays may cause tip burn during hot weather) soon after planting.

For a delayed or second application, apply 14 L/ha as a directed spray when the onions (except green onions) have developed three true leaves. Do not use within 45 days of harvest. Randox is recommended for use on soils high in organic matter or clay. It is less effective on sandy soils that are low in organic matter or clay.

Note: Registration of Randox may not be continued for 1986. Consult Manitoba Agriculture regarding availability and permit requirements.

Postemergence

Goal (192 g/L) Controls several broadleaf weeds in ***dry bulb onions only*** (Table 1). Apply 625 mL/ha in at least 500 L/ha water at a nozzle pressure of 275 kPa. Apply when the weeds are in the two to four leaf stage and actively growing. The first application can be made when the onions have two fully developed true leaves. More than one application may be necessary to control late germinating weeds. Do not apply in excess of 2.5 litres per hectare in one year. Do not apply Goal when the crop or weeds are under stress such as from excess or lack of moisture, extreme temperatures, or injury from a previously applied herbicide. Do not apply within 56 days of harvest. Do not apply preemergent or prior to the two leaf stage or severe injury to the onions may occur.

NOTE: Registration of Goal may not be continued for 1986. Consult Manitoba Agriculture regarding availability AND USE PERMIT REQUIREMENT.

Hoe Grass 284 (284 g/L) Controls certain annual grasses in **dry bulb onions only**. (Table 1) Apply 3.5 L/ha in at least 110 L/ha water at a nozzle pressure of 275 kPa. Direct nozzles 45° forward. Apply when weeds are in one to four leaf stage, and before they tiller. Other postemergence herbicides must be applied at least four days after Hoe Grass 284 application. Do not apply if rain is expected within one hour.

Totril (225 g/L) Controls several broadleaf weeds. (Table 1) Apply 2 L/ha in 400 L/ha water. Apply when weeds are in the seedling stage and after the crop is in the three leaf stage. Applications may be repeated after 14 days for late emerging weeds.

Disease Control

Downy Mildew, Botrytis Blast, purple Blotch These diseases develop in humid weather or when rain and heavy dews occur frequently. Begin spraying in mid June and spray every 7-10 days with one of the following fungicides: Anilazine 50WP 2.25 kg/ha (2 lb/acre); Difolatan 480F 5.5 L/ha (78 oz/acre); Mancozeb 80WP 2.25 to 3.25 kg/ha (2-3 lb/acre); Maneb 80 WP 2.25 kg/ha (2 lb/acre); Zineb 80WP 2.25 kg/ha (2 lb/

acre); for Botrytis blast only Iprodione 50WP 1.5 kg/ha (1.3 lb/acre). ***Zineb is the only fungicide registered for use on bunching onions.***

Storage Neck Rot Once the tops have been removed, dry rapidly with forced air at 35°C for the first week. The air temperature may then be reduced to 26°C until onions are well cured.

Smut Use the seed protectant fungicide, Pro-Gro (carbathiin + thiram) at 57 g/2.270 kg (2 oz/5 lb) seed. First moisten seed with methocel sticker solution at 29 ml Methocel per 580 ml hot water (1 oz/pint). Allow to stand overnight at room termperature. Add 29 ml of methocel solution to 454 grams (1 oz/lb) onion seed and mix thoroughly, or apply Thiram insecticide combination granules at the rate of 45 kg/ha (41 lb/acre) for 5% Thiram in crops seeded at 4 rows per bed or 56 kg/ha (51 lb/acre) for crops seeded at 5 rows per bed. When using granules containing 10% Thiram, use 22 kg/ha (20 lb/acre) for 4 rows per bed and 28 kg/ha (25.4 lb/acre) for 5 rows per bed, or Thiram 75 WP at 625 - 750 g/kg seed (10 oz./1 lb seed). Mix thoroughly.

Seedling Blight, Seed Decay Apply Thiram 75 WP at 65 to 80 g/25 kg seed (4·5 oz/10 lb seed) or Captan 75 at 340 g/4.5 kg seed (0.17 lb/10 lb seed).

Insect Control

Onion Maggots Either diazinon 5G at 280 to 460 g/300 m (10 to 20 ounces/1000 foot) row or Dasanit 15G at 7.5 kg/ha (6.6 lb/acre) or Lorsban 15G at 8 to 16 kg/ha (7.1 to 14.3 lb/acre) may be applied in the seed furrow at planting time. (Rates are for 40 cm (16 inches) row spacing).

Note:

- Avoid applying Dasanit to green bunch onions.
- Apply Lorsban 15G only with Pro-Gro treated seed.

Use only on dry and pickling onions. Pre-harvest wait period when applied with dry onions is 141 days and with pickling onions is 97 days.

Onion Maggot Flies and Thrips Spray regularly with diazinon 50EC at 1.1 L/ha (16 fluid ounces/acre) as an overall spray when flies appear, usually shortly after seedlings emerge and during July. Thrips may severely infest a crop during period of high temperature and drought conditions. A white flecking of the onion top evident in early summer, may be an indicator of thrip infestation.

Note: Onions left in the field after harvest are a major source of over wintering onion maggot. This is especially true following early harvest of Dutch sets and pickling onions. Prevent all regrowth. Remove where possible, or plow under immediately after harvest.

Sprout Inhibition

Apply maleic hydrazide (Royal MH 60SG) at rates recommended by the manufacturer. Apply to healthy plants when 50% of the tops are down.

Storage

If onions are dried in the field they should be well cured before placing in storage. Provide air circulation to keep them drying during storage. If onions are cured artificially, hold the forced air temperature at 35° C for the first and second week to kill neck rot organisms. For immature (greenish) slowly raise temperature to 32° C to avoid heat damage to the bulbs. Then reduce temperature to 26°C for the remainder of the curing process. When well cured, gradually reduce the storage temperature on onions as close to 0°C as possible.

Constant storage temperature is more important than actual temperature. Onions have stored well at temperatures varying from 0° to 13°C. The selected temperature must be held constant throughout the storage period to prevent sprouting.

Parsnips

Varieties

Model, All America, Guernsey

Seeding

Seed Always use fresh seed. Avoid using seed more than two years old.

Rate 3.3 to 5.6 kg/ha (3 to 5 lb/acre)

Row Spacing 45 to 60 cm (18 to 24 inches)

Depth 1.3 to 2.5 cm (½ to 1 inch) depending on moisture conditions. Deep seeding reduces stand.

Thinning Thin seedlings 5 to 10 cm (2 to 4 inches) in row.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

As a general recommendation apply 20 to 60 kg/ha (18 to 54 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 14.

Insect Control

Recommended insect control is identical as for carrots.

Weed Control

Postemergence

Afolan F (450 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1)

Apply 1.9 to 5 L/ha in 220 to 330 L/ha water. Do not apply with greater than 275 kPa. Spray when parsnips have two or more fully developed leaves. Use lower rates on small seedling weeds and the higher rates on larger established weeds. Apply before annual grasses exceed 5 cm in height and before broadleaves exceed 15 cm. During hot, dry weather spray in the cool part of the day to avoid injury.

Agricultural Weedkiller No. 1 (100%) Controls barnyard grass and several broadleaf weeds. (Table 1) Apply 600 to 800 L/ha as an overall treatment when crop is in the two to four leaf stage and before weeds are 10 cm tall. Spray in evening when humidity is high and the winds are light.

Caution: Do not mix Agricultural Weedkiller No. 1 with other herbicides.

1. If Afolan F is applied, wait 24 hours before applying Agricultural Weedkiller No. 1.
2. If Agricultural Weedkiller No. 1 is applied first, wait at least two weeks before applying Afolan F.

Disease Control

Watery Soft Rot (Sclerotinia). Handle the crop carefully to avoid wounds. Cull during harvest if rots are present. Disinfect storage area before storage using 2% solutions of copper sulphate (for example, 1 kg/50L or 2 lbs/100 gals water). Allow storage area to dry before storing parsnips. Follow a crop rotation of two years between successive crops. Avoid beans, lettuce, carrots, cole crops, rapeseed, peas, lentils, cucumber and celery since all are susceptible to Sclerotinia. Rotate with onions, beets, cereals or corn.

Peppers

Varieties

Sweet

Belle Types: Lady Belle, California Wonder, Green Boy, Cadice Hybrid, Staddon's Select, Hybrid Golden Bell, Ace Hybrid, Big Bertha

Pimento or Spanish: Earlired, Dutch Treat, Vinedale.

Hot

Red Hot, Hungarian Yellow, Gold Spike, Early Jalapeno, Anaheim

Transplants

Since pepper seeds germinate slowly, start plants in the greenhouse 9 to 10 weeks before they are set outdoors: 205 g of seeds produces transplants for 1 hectare (3 ounces for 1 acre). A temperature of 26° to 29°C is required to produce good germination and continued vigorous plant growth.

Plant small seedlings into flats when the first true leaves begin to grow. 5 to 6 cm (2 to 2-½ inches) are required between plants.

Pepper plants require some hardening before being placed in the field. To do this reduce temperatures to 15°C and cut down the water supply. This will give resistance to wilting.

Spacing Make rows 60 to 81 cm (2 to 2-½ feet) wide and allow 38 to 45 cm (15 to 18 inches) between transplants.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

The shock of transplanting can be reduced by applying a starter solution such as 10-52-17 when placing the plant in the field. Mix fertilizer at the rate of 454 g/45 L (1 lb to 10 gal) water and apply 284 *ml* (10 ounces) around the roots of each plant.

As a general recommendation apply 40 to 80 kg/ha (36 to 71 lb/acre) of nitrogen. Broadcast and incorporate 150 to 180 kg/ha (134 to 161 lb/acre) of phosphate (P_2O_5). Sand and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅛ of above rate and if potassium fertilizer is side-banded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Weed Control

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail, wild oats and several broadleaf weeds. Spring application only. Apply 1.6 to 2.8 L/ha Rival or 1.5 to 2.0 L/ha Treflan EC in at least 100 L/ha water. See product label or *1986 Guide to Chemical Weed Control* for specific application and incorporation instructions.

Insect Control

Flea Beeties, Aphids, Tarnished Plant Bug Spray with malathion 50 EC at 2.2 L/ha (32 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre) or spray with dimethoate (Cygon 4-E) 1 to1.4 L/ha (15 to 20 fluid ounces/acre). Dimethoate is not effective on flea beetles.

Pepper Maggot At weekly intervals starting the last week of June, apply Thiodan 4E at 2.8 L/ha (40 fluid ounces/acre) or dimethoate (Cygon 4-E) at 1 to 1.4 L/ha (15 to 20 fluid ounces/acre).

Note: Do not feed vegetables treated with Thiodan (Endosulfan) or Cygon (Dimethoate) to poultry or livestock.

Disease Control

Damping-Off Grow seedlings in sterilized soil. Use Captan 50 WP after seeding. Apply 175 mL (5 table-

spoons)/18 L (4 gal) water and drench flat. Repeat the application when the first true leaves appear. Apply sufficient spray to cover plants.

Wilt Verticillium wilt may be serious if crop rotation includes tomatoes, eggplant, sunflowers, alfalfa, sweet clover and potatoes. Follow a three to four year rotation with crops other than those mentioned.

Sunscald This may occur whenever fruit are excessively exposed to hot sun. A yellowish-white patch appears on the side of the fruit facing the sun. A blister-like area develops and which eventually becomes depressed, greyish-white with a dry paperlike surface.

Harvest

Peppers may be picked as soon as they reach marketable size. Remember they wilt quickly if too immature when picked. Sweet peppers are usually picked as green fruit. If they are left on the plant, they will turn red. Hot varieties should be left until they turn red.

Storage

Sweet peppers are stored only briefly, as they are not well adapted to long storage. Desirable temperatures are 7° to 10°C and relative humidity of 85 to 90 per cent Peppers are subject to chilling at temperatures below 7°C.

Potatoes

Varieties

Early Crop
Red — Norland
White — Carlton, Warba

Storage Crop
Red — Norland, Red Pontiac
White — Norchip, Kennebec, Shepody
Russet — Russet Burbank

Variety Description

Carlton An early maturing variety with white skinned, oval, shallow eyed tubers that size as early as Warba. Boiling quality is similar to Warba.

Warba An early maturing variety with pink eyed tubers which are rough, blocky and fairly deep eyed. It has good cooking quality and good yielding ability. Suitable for early harvest.

Norland A good yielding, early maturing variety with shallow eyes, oblong to round medium bright red skinned attractive tubers. Cooking quality is fair but subject to after cooking discoloration. Norland tubers have a short dormancy period, are moderately resistant to scab and susceptible to seed piece decay. Insect damage and drought frequently reduce its marketable yield.

Norchip A white, smooth, medium maturing variety with attractive, high specific gravity tubers with good chipping characteristics. Plants tend to have a heavy set of tubers. Growers can compensate for this with wider spacing in the row. Dormancy period is very short and sprout inhibition must be early if storage treatment is used.

Kennebec A very late high yielding variety with thin smooth skinned, shallow eyed large tubers. It is suitable for chipping but difficult to store unless quality seed is planted. Care should be taken during harvest to prevent damage. Greening frequently is a serious problem.

Red Pontiac A high yieliding, late maturing, drought tolerant variety with attractive red skinned medium deep eyed tubers. Dry matter content is low but tubers have a good white color after cooking. Following a period of dry weather, rain causes the tubers to enlarge rapidly predisposing them to skinning and shattering during harvest.

Russet Burbank A high quality, late maturing variety with russet skinned, shallow eyed tubers. It is particularly suitable for processing (other than chips) and baking. A consistent adequate supply of moisture is required for uniform tuber growth. Otherwise, very rough, knobby tubers will result. Hollow heart can be a severe problem.

Shepody A high quality, late mid-season maturing variety with large, white skinned, oblong to elliptical tubers. Yield, specific gravity and french fry color are similar to Russet Burbank. First harvest for processing expected to be acceptable at a minimum of 5 to 7 days earlier than Russet Burbank.

IN ROW SPACING GUIDE WITH BETWEEN ROW SPACING OF 38 INCHES (96 cm) FOR DRYLAND PRODUCTION

VARIETY	Seed		Table Stock		Processing	
	In.	cm	In.	cm	In.	cm
Carlton	9-11	23-28	11-13	28-33		
Kennebec	9-10	23-25			10-12	25-30
Norchip	12-13	30-33			13-14	33-36
Norland	11-13	28-33	12-13	30-33		
Red Pontiac	10-11	25-28	10-11	25-28		
Russet Burbank	12-13	30-33	15-16	38-40	17-18	43-46
Shepody*	12-15	30-38			15-18	38-46
Warba	12-13	30-33	13-14	33-36		

*Spacing Guide is based on limited data and field experience.

Seed Handling Practises

The regular purchase of Foundation or Certified seed is an excellent practice to follow. Handling techniques are also important.

Tubers should be cut into blocky seed pieces, 40 to 55 g (1-½ to 2 ounces) in size. Separate and discard chips and slivers below 28 grams (1 oz.) This reduces the number of weak plants in the field and increases yield potential.

Seed potatoes should be hauled, stored and handled with equipment that is thoroughly cleaned and disinfected. Use high pressure washers or steam for cleaning and a quaternary ammonium compound in solution under pressure for disinfecting. Use a quaternary ammonia product such as HY X, Potato Gard or Teramine, and mix using 600 ml product per 160 L water (20 oz/35 gal water) or household bleach (5% solution) at 600 ml product per 4.5 L water (20 oz product/gal water). Maintain a wet surface for a minimum of 10 min. when using a disinfectant.

Where practical, warm seed potatoes prior to cutting. This results in short, thick sprouts developing. While cutting potatoes, disinfect cutting and the handling machinery. If cut seed is not being planted immediately, very specific conditions for storage must be provided. These are:

- forced air circulation through the pile
- holding temperature of around 16°C and relative humidity of 85 to 95 per cent for at least 3 days
- after the curing period, maintain humidity but reduce temperature. Reduce air flow by operating fans intermittently.

Seed Treatment

Proper treatment of cut seed, will help assure a good stand of plants in the field.

Dry Treatment Apply one of the following: metiram (Polyram), captan or mancozeb (Dithane M-45, Manzate 200) or thiophanate methyl (Easout) according to manufacturer's directions. Application mechanism should provide a uniform coverage of dust over the surface of the cut tubers.

Wet Treatment Mancozeb flowable seed piece treatment — mix with equal part water. Apply 6 L of mixture/tonne of seed (1.2 gals/ton). Apply with spray equipment as used with mertect application. Allow for thorough coverage of seed pieces. Plant as soon as possible. If planting is delayed for more than 2 hours, store in shallow piles under forced ventilation. Do not bag wet seed pieces.

Less than six hours after cutting, dip pieces in Captan 50 per cent or 75 per cent WP at 3 kg/1000 L (3 lb/100 gal water). Plant immediately or if necessary store in shallow piles under forced ventilation.

Planting Requirements

SEED REQUIREMENTS FOR 38 INCH BETWEEN ROW SPACING (CWT/A)

	In-Row Plant Spacing (inches)					
Seed Set Weight (oz.)	**8**	**10**	**12**	**14**	**16**	**18**
1¼	16.1	12.9	10.7	9.2	8.1	7.2
1½	19.3	15.5	12.9	11.1	9.7	8.6
1¾	22.6	18.1	15.0	12.9	11.3	10.0
2	25.8	20.6	17.2	14.7	12.9	11.5

SEED REQUIREMENTS FOR 96 cm BETWEEN ROW SPACING (t/ha)

	In-Row Plant Spacing (cm)					
Seed Set Weight (g)	**20**	**25**	**30**	**35**	**40**	**45**
36	1.88	1.50	1.25	1.07	0.94	0.83
43	2.24	1.79	1.49	1.28	1.12	1.00
50	2.60	2.08	1.74	1.49	1.30	1.16
57	2.97	2.38	1.98	1.70	1.48	1.32

Fertilizer

For specific recommendations have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

All fertilizer should be added as a sideband application at time of seeding for the most efficient use of the fertilizer. No more than 90 kg/ha (80 lb/acre) nitrogen in urea form should be applied as a sideband application at time of seeding. When the crop is seeded less than five days after the application of anhydrous ammonia and aqua ammonia, damage may occur particularly on sandy soils or under dry soil conditions.

Excess nutrient levels may occur when high rates of fertilizer are used and can result in decreased quality and storage characteristics. Soil testing to a depth of 60 cm (24 inches) is strongly recommended to monitor nutrient levels and producers should avoid applying fertilizers at rates in excess of those recommended by a soil test.

Potatoes to be grown on	RATE OF NUTRIENT TO ADD							
	Nitrogen (N)[1]		Phosphate (P_2O_5)		Potash (K_2O)		Sulphur (S)	
	kg/ha	lb/acre	kg/ha	lb/acre	kg/ha	lb/acre	kg/ha	lb/acre
Fallow or legume breaking (2)	35-50	31-45	50-60	45-54	(3)	(3)	(4)	(4)
Grass and grass-legume breaking (2)	50-70	45-62	50-60	45-54	(3)	(3)	(4)	(4)
Stubble	70-100	62-89	50-60	45-54	(3)	(3)	(4)	(4)

(1) Rates are based on granular nitrogen applied broadcast at or near seeding time. See section Relative Efficiencies of Time and Method of Application, page 14.

(2) Refers to breaking after first cut of forage.

(3) Sands, sandy loam and organic soils are frequently low in available potassium. On these soils apply 50 to 90 kg/ha (45 to 80 lb/acre) of potash (K_2O).

(4) Twenty kg/ha (18 lb/acre) of sulphate sulphur (S) are recommended on well-drained sandy soils and grey luvisol (grey wooded) soils. For information regarding the application of the different forms of sulphur fertilizer refer to page 15.

Weed Control

Timely tillage with harrows, mulchers and cultivators supplemented with chemical weed control can be used to effectively control most weeds in potatoes. Timing of operations and chemical control measures must be selected for specific field conditions and weed problems.

Stale Seedbed

Refer to Weed Control Stale Seedbed on page 11.

Preplant Incorporated

Eptam 8-E (800 g/L) Eptam 10 G (10%) Controls several annual grasses and broadleaf weeds. (Table 1)

Spring application Apply 4.25 to 5.5 L/ha liquid or 34 to 45 kg/ha granular product. Apply liquid in at least 100 L/ha water. The granular product should be applied with a suitable granular applicator. Eptam must be applied to a dry soil surface of a well prepared seedbed. Incorporate immediately according to instructions on the product label or in the *1986 Guide to Chemical Weed Control*.

Fall application Although registered for fall application, the application and incorporation requirements for Eptam predispose soils to erosion and use is not recommended.

Quackgrass Control Spring application. Apply 7 to 8.5 L/ha liquid or 56 to 67 kg/ha granular product. Apply liquid in at least 100 L/ha water. Spray or broadcast on a dry soil surface. Incorporate immediately according to the *1986 Guide to Chemical Weed Control*.

Quackgrass must be cut up so that remaining rhizomes have four or less nodes prior to application.

Eptam 8-E may be applied with liquid fertilizer, or on granular fertilizer. Refer to the Herbicide Information section in the *1986 Guide to Chemical Weed Control* for specific instructions regarding application and use on dry fertilizer.

Caution: The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane, or Eptam or Sutan + the previous growing season. It is anticipated that the reduction in control will be greater where Eradicane, Eptam or Sutan + has been used repeatedly for two or more years.

Eptam 8-E (800 g/L) plus Sencor 500 (500 g/L) or Sencor 75 DF (75%) Controls annual grasses and several broadleaf weeds. (Table 1) Apply a tank mix of 550 to 850 mL/ha Sencor 500 or 375 to 550 g/ha Sencor 75 DF plus 4.25 to 5.5 L/ha Eptam 8-E. Do not use on varieties Belleisle, Shepody and Tobique or on soil with greater than 7 per cent organic matter. Refer to product label or *1986 Guide to Chemical Weed Control* for incorporation instructions.

Eptam 8-E (800 g/L) plus Lexone DF (75%) or Lexone L (480 g/L) Controls annual grasses and several broadleaf weeds. (Table 1) Apply a tank mix of 550 to 850 mL/ha of Lexone L or 350 to 550 g/ha of Lexone DF plus 4.25 to 5.5 L/ha Eptam 8-E. Do not use on soils with greater than 7% organic matter or on sandy or coarse textured soils with less than 2% organic matter or crop injury may result. Do not use on red-skinned potatoes or early potatoes or on the varieties Belleisle, Shepody or Tobique. Refer to product label or *1986 Guide to Chemical Weed Control* for incorporation instructions.

Caution: Fall seeded cover crops such as wheat, oats and rye may be injured when seeded the same season as application of Lexone or Sencor. Rapeseed, sunflowers, sugar beets and several horticulture crops may be sensitive to Lexone or Sencor residue the year following application. After harvest tillage practices that provide thorough mixing of the soil may be helpful in reducing the chance of injury to succeeding crops.

Preemergence

Basfapon (74%), Dalapon (74%), Dowpon (74%), Dowpon M (74%) Controls barnyard grass, green and yellow foxtail. Apply Basfapon at 5.5 to 7.75 kg/ha in 200 to 400 L/ha water, Dalapon at 3.25 to 6.75 kg/ha in at least 200 L/ha water, or Dowpon or Dowpon M at 3.4 to 6.8 kg/ha in at least 225 L/ha water. Do not apply after potatoes emerge and do not use on red skinned varieties.

Dalapon see Basfapon

Dowpon, Dowpon M see Basfapon

Eptam 8-E (800 g/L) - drag-off Controls several annual grasses and broadleaf weeds. (Table 1) Apply 4.25 to 8.5 L/ha. The field must first be "dragged-off", followed by Eptam 8-E application and incorporation. Use spike toothed harrows or cultivation equipment for incorporation. Refer to product label or *1986 Guide to Chemical Weed Control* for further incorporation and rate instructions.

Caution: The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane or Eptam or Sutan + the previous growing season. It is anticipated that the reduction in control will be greater where Eradicane, Eptam or Sutan + has been used repeatedly for two or more years.

Gramoxone (200 g/L) Controls annual grasses, broadleaf weeds and top growth of perennial weeds. Apply 2.75 to 5.5 L/ha in 300 to 1100 L/ha clean water to emerged weeds. Use the higher rate when weeds are above 5 cm in height and the higher volume of water on dense weed growth. Do not apply if more than 30 per cent of the potatoes have emerged. Do not apply to emerged plants in the evening, under cloudy conditions, or when plants are under moisture stress. Potatoes grown for early harvest should not be treated after emergence.

Roundup (356 g/L) Controls annual weeds. Apply 2.25 L/ha in at least 100L/ha water to actively growing grasses and broadleaf weeds less than 15 cm tall. If weeds are over 15 cm tall apply 3.5 L/ha. Apply to emerged weeds before or after planting, but before potatoes show above ground. Do not apply after potato emergence as Roundup will kill all green vegetation. Allow at least three days after treatment before disturbing the soil.

Controls perennial weeds. Refer to the Perennial Weed Control on Cropland section and the Special Weed Problems section in the *1986 Guide to Chemical Weed Control* for information on growth stages and rates of application. Also refer to product label.

Postemergence

Eptam 8-E (800 g/L) Sprinkler Irrigation Controls annual grasses and several broadleaf weeds. (Table 1) Meter 4.25 to 5.5 L/ha into first irrigation water following a clean cultivation. Do not apply within 45 days of harvest.

Caution: The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane, Eptam or Sutan+ the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Hoe Grass 284 (284 g/L) Controls certain annual grasses (Table 1). Apply 3.5 L/ha in at least 110 L/ha water at a nozzle pressure of 275 KPa. Direct nozzles 45° forward. Apply when weeds are in the one to four leaf stage and before they tiller. Other postemergent herbicides must be applied at least four days before or after Hoe Grass 284 application. Do not apply if rain is expected within one hour.

Sencor 500 (500 g/L) Sencor 75 DF (75%) Controls several broadleaf weeds. (Table 1) Apply 550 mL/ha Sencor 500 or 375 g/ha Sencor 75 DF in 100 to 300 L/ha water. Apply early postemergence soon after potatoes emerge and before weeds are 4 cm high. Do not use on the varieties Belleisle, Tobique, and Shepody. Do not use postemergence treatments on red skinned or on early maturing varieties. Do not apply within 60 days of harvest.

Fusilade (250 g/L) Fusilade was available for use in potatoes under a temporary registration granted by Agriculture Canada in 1985. At the time of printing, this registration was under review. For revised information concerning availability, application instructions, safety considerations and use precautions, see the 1986 Addendum to the *Guide to Chemical Weed Control* or consult your agricultural representative, weed supervisor or Chipman representative.

Lexone DF (75%), Lexone L (500 g/L) Controls several broadleaf weeds. (Table 1) Apply 550 mL/ha Lexone L or 350 g/ha Lexone DF in 100 to 300 L/ha water. Apply early postemergence soon after potatoes emerge and before weeds are 4 cm high. Do not use on red-skinned, Shepody, Belleisle, Tobique or any early maturing varieties. Do not apply within 60 days of harvest.

Disease Control

Practice crop rotations to prevent buildup in the soil of organisms that cause scab, black leg, Rhizoctonia and wilts. Avoid sunflowers, flax and rapeseed in the rotation. The plow down of a green cover crop of oats reduces rhizoctonia in the soil. Seed piece treatment reduces the risk of introducing diseases into a new field. For Verticillium wilt control treat seed pieces with thiophanate methyl (Easout). A crop rotation of four to five years is recommended. If a shorter rotation is being followed avoid sunflowers, sweet clover, tomatoes, peppers, eggplant and alfalfa which are susceptible to Verticillium wilt. Rotate with cereals.

Sanitation of all potato storage, handling and hauling equipment and disposal of all used bags is essential for bacterial ring rot control. Disinfect storages and equipment with a quaternary ammonia product such as Hy-X, Potato Gard, or Teramine, 0.6 L/160 L (one pint/35 gal) of water or household bleach, 5% solution at 700 ml/5L (20 oz/gal) water. Use high pressure washers or a steam cleaning unit to clean equipment before moving between fields, particularly for seed potatoes. Maintain a wet surface during disinfection for a minimum of 10 minutes.

Dispose of culls carefully to prevent growth of plants. This helps to avoid contamination of the upcoming crop with bacterial ring rot or late blight. Care should be taken to plant potatoes in soil sufficiently warm for growth (approximately 7 °C) in order to control blackleg, rhizoctonia and seed piece decay. A regular spray program will control early and late blight diseases.

Use of one or more of several fungicides according to directions on the label is recommended. Frequently, these disease control measures are combined with applications

of insecticides where the mixture is compatible. Refer to Table 4 for Fungicide/Insecticide compatability. Apply one of the following fungicides: maneb (Dithane M-22, Manzate D) at 2.2 kg/ha (2 lb/acre), mancozeb (Dithane M-45, Manzate 200) at 2.2 kg/ha (2 lb/acre), metiram (Polyram 80W) at 2.2 kg/ha (2 lb/acre), Difolatan 4.8F at 8.5 L/ha (1-½ qt/acre). Bravo 500 at 1.6-2.4 L/ha (24-36 oz/acre) or fixed copper 49 to 55 per cent 1.1 to 3.3 kg/ha (1 to 3 lb/acre). Refer to page 9 for pre-harvest wait period.

To control the storage diseases, silver scurf and fusarium dry rot, avoid bruising potatoes when harvesting. Treat potatoes while going into storage with thiabendazole (Mertect) at 8 L/170 L (1.9 gallons/40 gallons), spray 2L/tonne (64 oz/ton). Do not treat potatoes being exported with thiabendazole (Mertect) at the Canadian rates.

The United States rate is about one seventh of the Canadian rate. Consult current recommendations of the country to which the potatoes are being exported.

Insect Control

Leafhoppers, flea beetles, aphids and Colorado potato beetles are the major insects attacking potatoes in Manitoba. Aphids, because they transfer virus diseases, are of major concern to the seed grower. The following materials are suggested for insect control.

Flea beetles malathion 50EC at 2.2 L/ha (32 fluid ounces/acre), Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre), or Guthion SC at 2.25 to 3.5 L/ha (32 to 50 fluid ounces/acre) or Supracide 25EC at 1.1 L/ha (16 fluid ounces/acre), or Lorsban 4E at 1 L/ha (14 fl. oz./Acre), or Belmark at 98 to 160 mL/ha (1.4 to 2.3 fluid ounces/acre) or Ambush 500 EC at 140 — 200 mL/ha (2.0 — 3.5 fl oz/acre). Follow label directions.

Colorado potato beetles Guthion SC at 1.2 to 1.8 L/ha (17 to 25 fluid ounces/acre), Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre), SEVIN XLR at 1.25 L/ha (20 fluid ounces/acre) or Furadan 4.8F at 1.1 L/ha (16 fluid ounces/acre), or Monitor at 1.7 to 1.8 L/ha (24 to 26 fluid ounces/acre), or Supracide at 1.1 L/ha (16 fluid ounces/acre), or Belmark at 98 to 160 ml/ha (1.4 to 2.3 fluid ounces/acre), or Ambush 500 EC at 140 to 200 mL/ha (2.0 to 3.5 fluid ounces/acre), or Decis 2.5EC at 200 to 300 mL/ha (3 to 4 fluid ounces/acre), or Lorsban 4E at 1 L/ha (14 fluid ounces/acre), or Thimet 15G at 14.5 to 22.4 kg/ha (13 to 20 lbs/acre) to be applied at seeding. Follow label directions.

Potato leafhopper malathion 50EC at 1.7 L/ha (24 fluid ounces/acre) or SEVIN XLR at 1.25 L/ha (20 fluid ounces/acre) or Belmark at 98 to 160 ml/ha (1.4 to 2.3 fluid ounces/acre) or Ambush 500EC at 140 to 200 ml/ha (2.1 to 3.6 fluid ounces/acre) or Supracide at 2.2 L/ha (32 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fl oz/acre), or Guthion SC at 2.25 — 3.5 L/ha (33 to 55 fl oz/acre).

Aphids dimethoate 2E at 1.4 L/ha (20 fluid ounces/acre), malathion 50EC at 1.7 L/ha (24 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre), or Belmark at 100 to 300 ml/ha (1.4 to 4.2 fluid ounces/acre), or Guthion SC at 3.5 L/ha (50 fl oz/acre).

Cutworms Apply Lorsban 4C at 1.4 to 2.8 L/ha (20 to 40 fluid ounces/acre). Do not apply within 7 days of harvest. Apply Ambush 500EC at 0.14 L/ha (2.0 fluid ounces/acre) under good moisture conditions. Under dry conditions or when cutworm larvae are large and almost mature apply 0.23 to 0.30 L/ha (3.2 to 4.3 fluid ounces/acre).

Wireworms Broadcast Application Apply Dyfonate 10 G at 56 kg/ha (50 lbs/acre). Broadcast and incorporate into soil by discing or rototilling to a depth of 15 cm (6 inches) prior to planting.

Banded in furrow Application For irrigation soil only, apply Dyfonate 10G at 22.5 kg/ha (20 lb/acre) by regulated flow into fertilizer furrows at planting.

Sprout Inhibition

Field Application Apply maleic hydrazide (Royal MH 60SG) at the rates recommended by the manufacturer. This should take place about two weeks after full bloom and only when plants are actively growing and tops are green and healthy.

Storage Application Inject CIPC as a mist or fog to the storage building after potatoes have gone through the suberization period. Potatoes should be free of excessive dirt and other debris and the storage should have a ventilation system that moves air through the pile. Care should be taken when treating Norchip with CIPC because of a short dormancy period. Treat early and do not ventilate excessively.

Grading Application CIPC may be applied as a mist to tubers as they pass over the grader or through the wash line. This does not control sprouting in storage but is effective against the development of sprouts as the potatoes move through the market channels. Equipment to apply CIPC in this manner is not costly and the technique is suitable for growers with small or large volumes.

Vine Killing Use one of several dessicants such as dinoseb (e.g. Dytop, Dow General liquid with oil, etc.) or diquat (Reglone) as recommended by manufacturers. They will kill the tops of the plants, encourage earlier maturity and a higher percentage of marketable tubers. If the crop is left unharvested after top killing for 10 to 20 days, skins will set. This helps minimize skinning and bruising during harvest.

Field to Storage Transport

Hauling potatoes from field to storage when tubers are exposed to the air results in the drying of bruised and cut tissue. This dry surface prevents suberization and leaves the damaged areas open to infection and subsequent decay. Loads of potatoes should be covered with tarpaulins to protect the exposed tubers that are in transit or being held on the truck. This will increase relative humidity thereby reducing drying and allowing suberization to take place.

For the same reason it is important to protect cut seed from drying. Unsuberized seed is subject to a greater loss by seed piece decay.

Storage

The initial storage period is critical. Potatoes in which soft rot may develop should have initial storage temperatures of 8-10°C. Soft rot development can be expected when blackleg or frost are present. Where fusarium dry rot is present; initial storage temperatures of 10-18°C are most beneficial. Fusarium dry rot is most serious when soil conditions are dry and when tubers are injured during harvest. These conditions should be held for the first 10 to 14 days. Follow this period with a gradual drop in temperature while humidity is maintained at a minimum of 90 per cent. Operate humidification equipment in conjunction with fans. Humidifiers should be used whenever fans operate as long as the air entering the pile is at least slightly below tuber temperature. Exceptions to these conditions include potatoes which are damaged by fall frost or potatoes which develop the disease leak (usually result from harvesting when tuber/soil temperature is high). Under these circumstances it may be necessary to circulate the air at a lower relative humidity, (perhaps 80 per cent) through the pile until the condition is reduced.

Mechanical Damage

The greatest single cause of loss of tubers of marketable size and type is from mechanical damage. In the majority of cases storage rot problems are a direct result of damage inflicted on the tuber during harvesting and handling. Most organisms attacking the potato cannot penetrate the unbroken skin of the tuber. However, when the tuber is cut, bruised, squashed or otherwise mechanically damaged, a wide range of soil borne organisms are able to attack the tuber causing a rotting of the tissue.

Experiments indicate that many growers lose at least 15 per cent of the No. 1 grade potatoes they grow through mechanical injury. Prevent loss from mechanical injury by slowing down conveyors so they run full, reduce distances the tubers drop and roll, and provide adequate instruction, supervision and incentives for workers. Make sure trucks are filled in layers and piling in storage is done in steps to reduce rollback.

Good management of the harvest operation pays high dividends in reduced shrink in storage, higher percentage of No. 1 grade produce and higher net return per acre. In Idaho it is estimated that losses from bruising cost from $70 to $80 per acre. Losses in Manitoba are also very substantial.

Bruise Detection

Catechol System

Equipment:

- plastic pail
- plastic mesh bag or perforated plastic pail to fit inside the above.
- rubber gloves
- plastic funnel
- plastic jug (opaque)
- solution - 1% catechol, 99% water

Method Pour the solution in a plastic pail. Place tubers into mesh bag, immerse in catechol solution for one minute, remove, drain, and let stand for 5 to 10 minutes. After dipping samples, the solution may be stored in the plastic jug.

Results Exposed broken tissue will turn red and later reddish brown.

Sources of supply are:

Fisher Scientific
18 Plymouth
Winnipeg, Man.

Chemonics Scientific Ltd.
143 De Bets
Winnipeg, Man.

Canlab
590 Moray
Winnipeg, Man.

Time Delay System

Damaged tissue under an unbroken skin will not develop the reddish brown color when the catechol method is used. A complete appraisal of damage may be accomplished by peeling tubers 24 to 48 hours after the injury has occurred. The damaged areas will show up as grey to black spots in the white flesh of the peeled tuber.

Special Note

Where potatoes are being grown for a processing firm, take particular note of the company's recommendations in connection with insecticides, fungicides, top killers, sprout inhibitors and storage conditions. If company recommendations differ from those above, follow company specifications.

Radish

Varieties

Champion; Scarlet Knight; Cherry Belle.

Seed Treatment

Dust seed with thiram or captan seed protectant at 5 mL/454 g (one teaspoonful per pound) of seed.

Seeding and Spacing

Seed Sow seeds 1.3 cm (one half inch deep) at a rate of 11 to 16 kg/ha (10 to 15 lb/acre); 11 to 33 kg/ha (10 to 30 lb/acre) for machine harvesting.

Spacing Radishes are resistant to several degrees of frost, so seeding may start as soon as the land is ready in the spring. Maturity is reached in 21 to 26 days or longer in cool weather. Consecutive plantings can lengthen harvest period. Radishes are grown successfuly on peat land throughout the summer months. Only short to medium foliage varieties should be used.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and

15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

As a general recommendtion apply 20 to 50 kg/ha (18 to 45 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) of phosphate (P_2O_5). Sandy and sandy loam soils are frequently low in available potassium. On these soils, broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded, reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Weed Control

There are no recommended herbicides for radish.

Insect Control

Flea beetles Spray with malathion 50EC at 1.1 L/ha (16 fluid ounces/acre) or with Sevin XLR at 1.25 - 2.5 L/ha (20 - 40 fluid ounces/acre) just after plants emerge. Repeat as required.

Radish maggot Apply diazinon 5G at 560 g/300 m row) (20 ounces/1000 feet row) as plants emerge.

Rutabagas (Swede Turnip)

Varieties

Laurentian

Seeding

Dates:

Early Market: Plant in mid May when soil conditions are suitable and fear of heavy spring frosts is past.

Main Crop: Sow about the 8 June. This date may be set back two weeks if irrigation is available to maintain continuous growth.

Spacing Row spacing varies from 60 to 93 cm (24 to 36 inches). Sow 561 g to 1.1 kg/ha (one half to 1 lb/acre) seed depending on seed bed conditions.

Row Spacing Plants should be thinned to 12.5 cm (5 inches) in the row when they are 5 to 7.5 cm (2 to 3 inches) high. If a precision seeder is used, place the seed 10 cm (4 inches) apart in the row.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

Fertilizer is not recommended for the main storage crop. Excess fertility causes rapid growth and cracking under ideal growing conditions.

Boron deficiency — (Water-core, Brown Heart) As a preventative measure broadcast 22 kg/ha (20 lb per/acre) borax and work in prior to seeding. A foliar spray may be used. Reduce the rate to 4.5 kg/ha (4 lb/acre). Fields to which borax has been applied should not be planted to beans or cucumbers the following year as they are extremely sensitive to boron.

Growth Cracks Under rapid growing conditions the roots tend to crack at the shoulder and in severe cases the full length of the root. To prevent this clip as much as 25 per cent of the tops off with a rotary mower. Under very favorable conditions it may be necessary to repeat this operation. This will also prevent the crop from growing oversized before harvest for winter storage.

Weed Control

Stale Seedbed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated -
6 to 10 days before planting.

Eptam 8-E (800 g/L), Eptam 10 G (10%) Controls annual grasses and several broadleaf weeds. (Table 1) Apply 3.25 to 4.25 L/ha or 22.5 to 34 kg/ha granular product. Apply liquid in at least 100 L/ha water. The granular product should be applied using a suitable granular applicator. Eptam must be applied to a dry soil surface of a well prepared seedbed. See product label or *1986 Guide to Chemical Weed Control* for information on incorporation.

Caution: If dry weather prevails at the time of application, do not use Eptam on sand and use the lower rate on medium and heavy soils.

Caution: The level of weed control will be reduced where Eptam is used on soils which have been treated with Eradicane, Eptam or Sutan+ the previous growing season. It is anticipated that the reduction in control will be greater where these herbicides have been used repeatedly for two or more years.

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail, wild oats, and several broadleaf weeds. Spring application only. Apply 1.6 to 2.8 L/ha Rival or 1.5 to 2.0 L/ha Treflan EC in at least 100 L/ha water. See product label or the *1986 Guide to Chemical Weed Control* for specific application instructions.

Disease Control

Clubroot Refer to Cabbage, Cauliflower, Brussel Sprouts, Broccoli "Disease Control" section.

Blackleg and Black Rot Rotate crops - do not plant turnips, rape, cabbage and other crucifers more than once every three years on the same land. Sow seed which has been hot water treated for 20 minutes at 50°C. Avoid field work when foliage is wet.

Seed Decay, Damp Off For control use seed treated with Captan or Thiram.

Soft Rot Control root feeding insects such as maggots. Avoid bruising roots as much as possible during cultivation and harvesting. Harvest under dry conditions if possible. Store close to O°C and 95 per cent humidity (see harvesting and storing section). If soft rot of the trimmed surface appears, trim the roots after the initial pre-soaking to remove adhering soil. Use clean water for final rinsing. Dry roots after washing and store at a cool temperature until shipped. Disinfect storage bins with a 2 per cent copper sulphate solution or other disinfectant prior to harvest.

Brown Heart, Water-core (see boron deficiency under **Fertilizer**).

Insect Control

Root maggots Do not grow rutabagas near a previously infested field, or an early sown field of cabbage or cauliflower. Apply Dasanit 15G at 345 g/300 m row (13.3 oz/1000 feet row) in a 15 cm (6 inch) band over the row and incorporate in the top 2.5 cm (1 inch) of soil and seed into the centre of the row, or Furadan 10G at 567 g/300 m row (20 ounces/1000 feet row). Apply granules in 10 cm (4 inch) band, 2.5 cm (1 inch) below soil surface. Plant seed 1 cm (half-inch) above centre of band. This may be followed by an overall spray of Furadan 4.8F at 5.25 L/ha (75 ounces/acre) or diazinon 4E at 2.25 L/ha (32 fluid ounces/acre) in early July and again in mid-August to control the maggot flies.

Caution: If Furadan is applied, only one application is permitted on products grown for export.

Flea beetles Spray with malathion 50EC at 2.2 L/ha (32 fluid ounces/acre) or Thiodan 4E at 2 to 3 L/ha (30 to 40 fluid ounces/acre) as plants emerge and repeat as required, or Diazinon 500 EC at 1.1 L/ha (16 fl oz/acre).

Aphids If the crop is attacked, spray with either malathion 50EC at 2.2 L/ha (32 fluid ounces/acre) or Thiodan 4E at 2.1 L/ha (30 fluid ounces/acre) in at least 224 L (20 gal) water.

Note: Do not feed rutabaga refuse treated with Thiodan (endosulfan) to livestock or poultry.

Sprout Inhibition

Apply maleic hydrazide (Royal MH 60SG) at rates recommended by the manufacturer. Apply to healthy plants which have tops in good condition four to six weeks before harvest.

Harvesting and Storing

If possible, harvest when weather is cool and avoid bruising. Roots will store up to eight months if temperatures are held at 0 °C and a relative humidity of 95 per cent. Remove field heat as rapidly as possible to prevent initial shrinkage and discoloration. If forced air is used, additional moisture should be added to the air stream. Do not soak pile with water hose.

Trimming When preparing roots for market, the top should be removed at the crown. Trimming into the crown should be avoided. Remove side rootlets and the main tap root below the enlarged area of the root.

Tomatoes

Varieties

Staking Fantastic, Moreton Hybrid, Valiant, Better Boy, Early Cascade.

Bush Prairie Pride, Mustang, Starfire, Manitoba, Swift, Saladette, Earlirouge

Transplants

Plants for transplanting should be strong and vigorous with no signs of disease. Too early plantings should be avoided. Four to seven week old seedlings have proven as much or more productive than 11-week old plants. Severe hardening is not recommended as recovery is slow and delays maturity.

The number of flowers and fruit on the first two to three clusters will increase if seedlings are grown at night temperatures 10 ° to 13 °C for a period of 3 weeks after the first true leaf appears. This may be done before or after the first transplanting. Return the seedlings to temperatures of 15 ° to 18 °C after this treatment.

Row Spacing *Staking* — 1 m x 45 cm (3.5 feet x 18 inches)
Bush — 1.2 m x 45 cm (4 feet x 18 inches)

Seed Treatment

Use hot water treated seed from a reliable seed source or apply 75 per cent thiram or 75 per cent captan seed protectants (if seed not already treated).

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

To reduce the setback in transplanting, use a high phosphorus fertilizer such as 10-52-17. Mix at the rate of 454 g/45L (1 lb/10 gal) water and apply 284 mL (10 fluid ounces) per plant.

As a general recommendtion apply 40 to 80 kg/ha (36 to 71 lb/acre) nitrogen. Care should be taken in application of nitrogen. Too much will cause excessive vegetative growth, delayed maturity, or lack of fruit set. Broadcast and incorporate 150 to 180 kg/ha (134 to 161 lb/acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Weed Control

Preplant Incorporated

Rival (500 g/L), Treflan EC (545 g/L) Controls green and yellow foxtail, wild oats, and several broadleaf weeds. Spring application only. Apply 1.6 to 2.8 L/ha Rival or 1.5 to 2.0 L/ha Treflan EC in at least 100 L/ha water. See product label or the *1986 Guide to Chemical Weed Control* for specific application instructions.

Disease Control

Early blight, late blight, Septoria leaf spot Treat with one of the following in early July when the first fruit reaches golf ball size or when first signs of leaf spotting occurs:

Maneb (Dithane M22, Manzate D), 3.4 kg/ha (3 lb/acre)

Mancozeb (Dithane M45, Manzate 200), 3.4 kg/ha (3 lb/acre)

Captafol 4.8F at 2.75-5.5 L/ha (40-80 oz/acre)

Metiram (Polyram 80W), 3.4 kg/ha (3 lb/acre)

Chlorothalonil (Bravo 500) at 2.4-4.0 L/ha (36-60 oz/acre)

Zineb (Dithane Z78), 3.4 kg/ha (3 lb/acre)

or fixed coppers 49 to 55 per cent (Kocide 101, Tricop, neutro-cop) at 3.4 to 5.6 kg/ha (3 to 5 lb/acre).

Repeat every 7 to 10 days. Follow manufacturer's directions.

Blossom end rot Maintain uniform soil moisture throughout the growing season and avoid close cultivation. If blossom end rot occurs, apply 2.3 to 5.6 kg/ha (2 to 5 lb/acre) calcium chloride as a spray during the fruit development period, particularly during periods of hot humid weather. Repeat applications weekly at a lower rate.

Physiological Leaf Roll This condition occurs quite often just prior to ripening of the first fruits. It is more common on staking varieties than on bush types. Symptoms are thickening of the lower leaves accompanied by a tendency to roll inwards. The leaves become very brittle and damage easily. Leaf roll may be caused by irregular water supply or severe pruning. It is a temporary condition and appears to have no effect on crop yield or quality.

Bacterial Spot, Bacterial Speck Use only hot water treated seed, 50°C (122°F) for 25 minutes. Avoid working in wet fields and avoid sprinkler irrigation. Do not replant tomatoes or related plants for at least 2 years in a field where the disease has been found. Spray plants with Cupric hydroxide 56 WP 2.7 kg/ha (2.5 lb/acre) plus maneb 80 WP or mancozeb 80 WP 1.8 kg/ha (2 lb/acre) mixture. (Preharvest interval of 3 days for cupric hydroxide and maneb, 1 day for cupric hydroxide and mancozeb.)

Fusarium and Verticillium Wilt Follow a crop rotation by allowing 3 to 4 years between successive crops. Do not include peppers, eggplant, sunflower, alfalfa, sweet clover or potatoes in the rotation. Most commercial cultivars have resistance to Fusarium and/or Verticillium wilt.

Sun Scald See Peppers for description of injury.

Insect Control

Flea beetles Spray with malathion 50EC at 1.1 L/ha (16 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre).

Variegated cutworm Spray SEVIN XLR (evening) at 1.25 - 2.5 L/ha (20 - 40 fluid ounces/acre) or thiodan 4E at 1.4 L/ha (20 fluid ounces/acre).

Slugs See slugs under Celery and **General Pesticide Recommendations.**

Artificial Ripening of Mature Greens

For all around color, flavor and handling ability, ripen mature green tomatoes at 21°C.

Tomatoes develop their most intensive red color and flavor when held at 21°C for ripening. At temperatures above 24°C the fruit ripens on the soft side lacking flavor, color and firmness. If they are held at temperatures below 10°C for extended periods of time, the fruit will not ripen fully even though it is returned to ideal ripening conditions. After the fruit has reached a firm/ripe stage it may be held at temperatures of 7°C without loss of color or flavor.

Vine Crops

Cucumbers

Varieties

Pickling: Green Spear 14, Perfecto Verde, Alouette, Carolina

Slicing: Burpeeana Hybrid; Ashley, Burpee's Hybrid, Saticoy Hybrid, Marketmore, Burpless Hybrid, Victory

Bread & Butter: Japanese Long; China

Seed Treatment

Apply captan or thiram to the seed according to manufacturer's instructions.

Seeding

Cucumbers are frost tender, thriving only if weather is warm. Delay seeding and transplanting until late May and early June when soil temperatures are 16°C or higher. Cucumbers may be raised either from transplants, for early crops, or from direct seeding in the field. About 2.2 kg/ha (2 lb/acre) of seed is required to produce enough transplants for one hectare.

For direct seeding of cucumbers 4.5 to 5.5 kg/ha (4 to 5 lb/acre) are required.

Sow cucumbers at a depth of 1.3 - 2.5 cm (½ to 1 inch).

Suggested spacing requirements: rows 1.2 to 1.8 m (4 to 6 ft.), plants 30 to 38 cm (12 to 15 inches) apart.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

When using transplants, the application of a starter fertilizer such as 10-52-17 or 10-40-10 is recommended. Mix at a rate of 454 g (1 lb) fertilizer in 45 L (10 gal) water and apply 284 to 300 mL (one-half pint) per plant.

As a general recommendation apply 20 to 60 kg/ha (18 to 54 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅛ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre) of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Irrigation

Good moisture is necessary throughout growing season. Irrigate to supply 2.5 cm (1 inch) water after seeding or transplanting. Good moisture reserves are also necessary at time of flowering and fruit development *Do not let soil dry out during this period.* Avoid irrigation while bees are working the field by irrigating in the late afternoon or evening.

Pollination

All vine crops depend on insects to transfer pollen from male to female blossoms. These are borne separately on the same plant. To ensure adequate pollination introduce one colony of honeybees for every 2 to 3 acres.

Weed Control

Stale Seedbed

Refer to Weed Control
Stale Seedbed on page 11.

Preplant Incorporated

Prefar (480 g/L) Controls barnyard grass, green and yellow foxtail. Apply 12 to 14 L/ha in 100 to 500 L/ha water. Incorporate 2.5 to 5 cm. See caution regarding residue under Prefar plus Alanap 3 recommendation.

Prefar (480 g/L) plus Alanap 3 (240 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply 9.5 to 14 L/ha Prefar plus 9.5 to 19 L/ha Alanap 3. Apply as a tank mix in 100 to 400 L/ha water. Incorporate lightly 1 to 3 cm. Use lower rate on light sandy soils.

Caution: Do not apply Prefar more often than once every 12 months. To avoid crop injury rotate only to cucumbers, peppers, cole crops, carrots, lettuce or tomatoes.

Preemergence

Dyanap (330 g/L) Controls barnyard grass, green and yellow foxtail and several broadleaf weeds. (Table 1) Apply 14 to 17 L/ha in 200 to 400 L/ha water. Thorough and uniform coverage of the surface is essential for good weed control. If soil is cold at time of seeding delay Dyanap application until soil temperature warms up. Do not apply after crop has emerged.

Insect Control

Cucumber Beetles Spray or dust when plants are breaking through, and at weekly intervals with rotenone or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre) or Guthion SC at 2.3 L/ha (33.5 fluid ounces/acre).

Aphids Spray with malathion 50 EC at 2.2 L/ha (32 fluid ounces/acre) or Thiodan 4E at 1.4 L/ha (20 fluid ounces/acre) when required.

Apply insecticides in the evening when bees are not working fields. If hives are in crop, cover them when treating field.

Disease Control

Angular Leaf Spot (Cucumbers) Follow a three year crop rotation. Apply one of the following: fixed copper (Tri-cop, Neutro-cop, Basi-cop, Kocide 101) at 3.4 kg/ha (3 lb/acre) if disease appears. Destroy vines after harvest. See page 8 for fungicide pre-harvest waiting period.

Bacterial Wilt (Cucumber, Pumpkins, Squash) Control the cucumber beetles which transmit the disease (see cucumber beetles).

Seed Decay and Damping Off (Cucumbers, Pumpkins, Squash) Treat seed (if not already treated by seed company) with one of captan, thiram or dexon seed treatment fungicides.

Powdery Mildew and Scab (Cucumbers, Pumpkins, Squash) Use disease free seed and apply one of these fungicides: benomyl (Benlate 50W) at 0.6 to 1 kg/ha (8-10 oz/acre), or chlorothalonil *(Bravo 500) at 3.2 to 4.8 L/ha (48-72 oz/acre)* applied every 7 to 10 days. See Table 3 for fungicide pre-harvest waiting period.

Storage

Cucumbers should be stored at 7° to 10°C and 95 per cent relative humidity. A storage life of 7 to 10 days can be expected. Cucumbers are sensitive to chilling injury at temperatures below 7°C. Avoiding moisture loss is important.

Muskmelon and Watermelon

Cultivars

Muskmelon — Alaska, Earlisweet, Sweet and Early, Gold Star, Burpee Hybrid, Sweetheart, BUX 5-74 (green flesh)

Watermelon — Stokes Sugar Hybrid, Northern Delight, Wide Ranger, Sugar Delicata, Sugar Belle.

Planting Melons

The use of transplants is recommended for earlier harvest. Four week old plants grown in peat pots should be set out after the danger of frost is past. The plants should be planted through a clear plastic mulch or under plastic tunnels for optimum growth.

Plant Spacing

Muskmelon — 2.1 m (7 ft.) between rows and 0.6 m (2 ft.) between plants

Watermelon — 2.4 m (8 ft.) between rows and .9 m (3 ft.) between plants

Fertilizer, Irrigation, Disease Control Same as for cucumbers.

Weed Control

1) Stale seedbed, see page 11
2) Preplant Incorporated

Alanap (240 g/L) Controls several germinating annual weeds (Table 1). Apply 11.0 to 30.0 L/ha as a preemergence spray to melons in 250 to 300 L water per hectare up to 48 hours after planting. Soil clods should be thoroughly broken up and pulverized to give a smooth surface and the soil should not be disturbed unless later weed growth makes cultivation necessary. Thorough, uniform coverage of the soil surface is necessary. Do not apply during very wet, cold weather as stunting of the crop may result. Alanap may be applied to melons as a postemergence spray about one month after the preemergence spray when the crop has emerged, but before the weeds are up. Do not apply during cold, wet weather as stunting of the crop may result. Use lower rates on light soils, higher rates on heavy soil. Good soil moisture is required to activate the herbicide.

Harvesting and Storage

Muskmelon — Fruit is ripe when vine is easily pulled (slipped) from the fruit. If marketing through wholesale-retail, fruit should be picked a few days before fully ripe. Rapid removal of field heat improved shelf life and marketing should be done immediately after harvest. Short-term storage can be done at temperatures near 10°C.

Watermelon — Experience is needed to determine when certain cultivars are ripe. A dull, hollow sound when rapped and a yellow ground spot usually indicate ripeness. Fruit must be cut off the vine leaving a short stem attached. Fruit can be stored for a few weeks at 10°C and will continue ripening after harvest at temperatures of 12 to 18°C.

Squash and Pumpkin

Varieties

Squash

Summer Squash: Green zucchini types — Diplomat, Zucchini, Zucchini Select, Black Jack.

Yellow Straightneck types — Goldbar, Goldzini, Gold Rush.

Scallop types — St. Pat Scallop.

Marrow types — Vegetable Marrow.

Winter Squash: Acorn types — Table acorn

Buttercup types — Buttercup

Butternut types — Waltham Butternut

Hubbard types — Baby Hubbard

Other Winter Squash — Vegetable Spaghetti

Pumpkin

Jack O'Lantern, Funny Face, Cinderella, Big Max, Spirit

Seed Treatment

Apply captan or thiram to the seed according to manufacturer's instructions.

Seeding

Squash and pumpkins are frost tender thriving only if weather is warm. Delay seeding and transplanting until late May or early June when soil temperatures are 16°C or higher. Pumpkins and squash may be raised either from transplants, for early crops, or from direct seeding in the field. About 2.2 kg/ha (2 lb/acre) of seed is required to produce enough transplants for one hectare.

Squash and pumpkin seeding rates vary somewhat with seed size for direct seeding. Large-seeded cultivars will require 1 to 1.5 kg/ha (1 to 1½ lb/acre).

Suggested spacing requirements for Pumpkin (Standard) and Winter Squash: Rows 1.8 to 2.5 m (6 to 8 feet), plants 90 to 120 cm (3 to 4 feet) apart. For Pumpkin (Bush) and Summer Squash: rows 90 to 120 cm (3 to 4 feet), plants 60 to 90 cm (2 to 3 feet) apart.

Sow squash/pumpkin at 2.5 cm (1 inch) depth.

Fertilizer

For specific recommendations, have your soil tested. Take samples at depths of 0 to 15 cm (0 to 6 inches) and 15 to 60 cm (6 to 24 inches). See tables 5 to 8 on pages 57 to 60 for individual recommendations based on a soil test analysis.

When using transplants, the application of a starter fertilizer such as 10-52-17 or 10-40-10 is recommended. Mix at a rate of 454 g (1 lb) fertilizer/45 L (10 gal) water and apply 284 to 300 mL (one-half pint) per plant.

As a general recommendation apply 20 to 60 kg/ha (18 to 54 lb/acre) of nitrogen and broadcast and incorporate 120 to 160 kg/ha (107 to 143 lb/acre) phosphorus (P_2O_5). Sands and sandy loam soils are frequently low in available potassium. On these soils broadcast and incorporate 130 to 170 kg/ha (116 to 152 lb/acre) of potash (K_2O). If phosphate fertilizer is sidebanded reduce rate to ⅓ of above rate and if potassium fertilizer is sidebanded, above rate can be reduced by ½. 30 kg/ha (27 lb/acre)

of **sulphate** sulphur (S) is recommended on well drained sandy soils. For information on the application of different forms of sulphur fertilizer, see page 15.

Irrigation

See **Cucumbers**

Pollination

See **Cucumbers**

Weed Control

Carry out between row cultivation prior to vining. Avoid damage to root systems by using shallow cultivation and keeping a good distance from roots. Hand hoe within row.

Insect Control

See **Cucumbers**

Disease Control

See **Cucumbers**

Storage

Summer squash should be stored at 7° to 10°C and 95 per cent relative humidity. A storage life of 7 to 10 days can be expected. Summer squash are sensitive to chilling injury at temperatures below 7°C. Avoiding moisture loss is important.

Pumpkins and winter squash store best at 7° to 10°C and 70 to 75 per cent relative humidity. These crops should be cured for two weeks at 25° to 30° C to aid the healing of minor injuries. After curing, temperatures should be reduced to the 7° to 10°C range. Storage life of pumpkins and squash depends largely on their type and variety.

Additional Information

Seed Companies

These seed companies are commonly used by vegetable growers. However, the list is neither an endorsement of them or a suggestion that other companies do not supply vegetable seed. It is only provided as information for growers:

Agway Inc., Seed Plant
RD 4, Zeager Rd.
Elizabethtown, PA 17022

Alberta Nurseries and Seeds Ltd.
Box 20
Bowden, Alberta T0M 0K0

Asgrow Canada Ltd.
Box 610
Bradford, Ontario L0G 1C0

Asmer Seeds Limited
Asmer House
Ash Street
Leicester, England L35 0DD

W. Atlee Burpee Co.
300 Park Avenue
Warminster, PA 18991

Bejo zaden
P.O. Box 9
Noordscharwoude, Holland

Buckerfields
Box 7000
Vancouver, B.C. V6B 4E1

D.V. Burrell Seed Growers Co.
P. O. Box 150
Rocky Ford, Colorado 816067

Crookham Co.
P. O. Box 520
Caldwell, Idaho 83605

De Giorgi Company Inc.
1411 Third Street
Council Bluffs, Iowa 51502

Dominion Seedhouse
Georgetown, Ontario L7G 4A2

Ferry-Morse Seed Co.
111 Ferry-Morse Way
P.O. Box 100
Mountain View, Cal. 94040

Gallatin Valley Seed Co.
Box 167
Twin Falls, Idaho 83301

Harris Seeds of Canada Ltd.
Hwy. 6, RR 2
Hamilton, Ontario L8N 2Z7

Herbst Brothers Seedsmen
1000 N. Main Street
Brewster, N.Y. 10509

Kackenhoff Nurseries
Box 2000
St. Norbert, Man. R3V 1L4

Lindenberg Seeds Ltd.
803 Princess Ave.
Brandon, Man. R7A 0P5

McFayden Seeds
P.O. Box 1800
Brandon, Manitoba R7A 6N4

Moran Seeds
1155 Harkins Rd.
Salinas, California 93901

Northrup King Co.
P.O. Box 1827
Gilroy, California 95020

W.H. Perron & Co. Ltd.
515 Labelle Boulevard
Lavel, Quebec H7V 2T3

Petoseed Co., Inc.
Box 4206
Saticoy, Cal. 93004

Robertson Seeds Ltd.
8118-103rd Street
Edmonton, Alberta T6E 4B1

Royal Sluis
Postbox 22 - 1600 AA
Enkhuizen, Holland

Charles Sharpe and Co. Ltd.
Sleaford, Lincolnshire NG347HA
England

Siegers Seed Co.
7245 Imlay City Rd.
Imlay City, Michigan 48444

Stokes Seeds Ltd.
39 James Street
Box 10
St. Catharines, Ontario L2R 6R6

Sun Seeds
Agrigenetics Corp.,
Vegetable Products Group
9531 West 78th St., Suite 229
Eden Prairie, MN 55344

T & T Seeds Ltd.
Box 1710
Winnipeg, Manitoba R3C 3P6

Unwins Seeds Ltd.
Histon, Cambridge
England CB4 4LE

Vesey's Seeds Ltd.
York, Prince Edward Island C0A 1P0

Westcan Horticultural Specialists Ltd.
1900 - 11th Street S.E.
Calgary, Alberta T2G 3G2

William Dam Seeds
P.O. Box 8400
Dundas, Ontario L9H 6M1

Certified Seed Potato Producers in Manitoba

A. M. Briggs Ltd.,
Box 273, Portage la Prairie, Manitoba R1N 3B5

A & M Potato Growers, Wellwood, Manitoba.

M. J. Gowryluk & Sons,
Box 144, Holland, Manitoba R0G 0X0

Kroeker Farms Ltd.,
Box 1450, Winkler, Manitoba R0G 2X0

Swans Fleet Farms Ltd.,
Bruxelles, Manitoba R0G 0G0

Vista Farms Ltd.,
Box 73, Plum Coulee, Manitoba R0G 1R0

Detailed information on certification class, varieties and volumes of seed for sale can be obtained by contacting the Manitoba Vegetable Producers Marketing Board, 1200 King Edward Street, Winnipeg, Manitoba, R3H 0R5 (204) 633-9336 or the growers directly.

Metric Equivalents

Volume (liquid)		
fluid ounce (Imp)	=	28.412 mL
pint	=	0.568 litre
gallon	=	4.546 litres
litre	=	35.2 fluid oz
hectolitre	=	26.418 gal
Length		
inch	=	2 54 cm
foot	=	0.3048 m
yard	=	0.914 m
mile	=	1.609 km
millimetre	=	0.039 in
centimetre	=	0.394 in
decimetre	=	3.937 in
metre	=	3.28 ft
kilometre	=	0.621 mile
Volume (dry)		
cubic inch	=	16.387 cm^3
cubic foot	=	0.028 m^3
cubic yard	=	0.765 m^3
bushel	=	36.368 litres
board foot	=	0.0024 m^3
cm^3	=	0.061 cu in
m^3	=	31.338 cu ft
hectolitre	=	2.8 bu
m^3	=	1.308 cu yd
Proportion		
1 gal/acre	=	11.232 litres/ha
1 lb/acre	=	1.120 kg/ha
1 lb/sq in	=	0.0702 kg/cm^2
1 bu/acre	=	0.898 hL/ha
1 litre/ha	=	14.24 fluid oz/acre
1 kg/ha	=	14.5 oz avdp/acre
1 kg/cm^2	=	14.227 lb/sq in.
1 hL/ha	=	1.112 bu/acre
Area		
square inch	=	6.452 cm^2
square foot	=	0.093 m^2
square yard	=	0.836 m^2
square mile	=	2.59 km^2
acre	=	0.405 ha
cm^2	=	0.155 sq in
m^2	=	1.196 sq yd
km^2	=	0.386 sq mile
ha	=	2.471 acres
Weight		
ounce	=	28.349 g
pound	=	453.592 g
hundredweight (Imp)	=	45.359 kg
ton	=	0.907 tonne
gram	=	0.035 oz avdp
kilogram	=	2.205 lb avdp
tonne	=	1.102 short ton
Temperature		
°F	=	(°C x 1.8) + 32
°C	=	(°F — 32) x 5/9

Conversion Factors

Imperial units	Approximate conversion factor	Results in:
Linear		
inch	x 25	millimetre (mm)
foot	x 30	centimetre (cm)
yard	x 0 9	metre (m)
mile	x 1.6	kilometre (km)
Area		
square inch	x 6.5	sq centimetre (cm^2)
square foot	x 0.09	square metre (m^2)
acre	x 0.40	hectare (ha)
Volume		
cubic inch	x 16	cu centimetre (cm^2)
cubic foot	x 28	cubic decimetre (dm^3)
cubic yard	x 0.8	cubic metre (m^3)
fluid ounce	x 28	millilitre (mL)
pint	x 0.57	litre (L)
quart	x 1.1	litre (L)
gallon	x 4.5	litre (L)
bushel	x 0.36	hectolitre (hL)
Weight		
ounce	x 28	gram(g)
pound	x 0.45	kilogram (kg)
short ton (2000 lb)	x 0.9	tonne (1)

Pressure		
pound per square inch	x 6.9	kilopascal (kPa)
Power		
horsepower	x 746	watt (W)
	x 0.75	kilowatt (kW)
Speed		
feet per second	x 0.30	metres per second (m/s)
miles per hour	x 1.6	kilometres per hour (km/h)
Agriculture		
gallons per acre	x 11.23	litres per hectare (L/ha)
quarts per acre	x 2.8	litres per hectare (L/ha)
pints per acre	x 1.4	litres per hectare (L/ha)
fluid ounces per acre	x 70	millilitres per hectare (mL/ha)
tons per acre	x 2.24	tonne per hectare (t/ha)
pounds per acre	x 1.12	kilograms per hectare (kg/ha)
ounces per acre	x 70	grams per hectare (g/ha)
plants per acre	x 2.47	plants per hectare (plants/ha)

Metric Measurements

Symbols

Length:		Pressure:		Area:	
mm	millimetre	kPa	kilopascal	cm^2	sq centimetre
cm	centimetre			m^2	square metre
m	metre			ha	hectare
km	kilometre			km^2	sq kilometre

Weight:		Volume:		Temperature:	
g	gram	mL	millilitre	°C	degrees Celsius
kg	kilogram	L	litre		
t	tonne	hL	hectolitre		
		m^3	cubic metre		

Measures

Length:		Volume:	
10 mm	1 cm	1 000 mL	1 L
100 cm	1 m	100 L	1 hL
1 000 m	1 km	1 000 L	1 m^3

Weight		Area:		
1 000 g	1 kg	10 000 cm^2	1 m^2	(100 cm x 100 cm)
1 000 kg	1 t	10 000 m^2	1 ha	(100 m x 100 m)
		100 ha	1 km	(1000 m x 1000 m)

Imperial Measurements

1 imperial gallon = 4 quarts = 8 pints = 160 fluid ounces
1 U.S. gallon = 5/6 imperial gallon
1 imperial quart = 40 fluid ounces
1 imperial pint = 20 fluid ounces
1 mile = 5280 feet = 1760 yards = 320 rods
1 rod = 16.5 feet = 5.5 yards
1 acre = 43,560 square feet = 4,840 square yards = 160 square rods
1 mile an hour = 88 feet/minute

Related Publications

These publications are available from the Publications Section, Manitoba Agriculture, 411 York Avenue, Winnipeg, Manitoba R3C 1M5.

Manitoba Agriculture Publications

Diseases of Vegetables and Special Crops (charts)
Insect Control on Home Gardens
Growing Potatoes in the Home Garden
Recommended List of Vegetables for Manitoba
Guide to Chemical Weed Control
Fertilizer Recommendations for the Home Garden
Grasshopper Control in Manitoba
Nitrogen Fixation and Legumes in Crop Production
Nitrogen Fertilization in Crop Production
Phosphorous Fertilization in Crop Production
Soil Testing Services in Manitoba
Micronutrients in Crop Production
Plant Tissue Analysis
Calculating Nutrient Costs and Fertilizer Rates
A 1983 Consensus Budget of Costs and Revenues for Table
Carrot Production (available Portage La Prairie Regional office 857-9711)
Onions (available from Portage La Prairie Regional office 857-9711)

Agriculture Canada Publications

Home Storage Room for Fruits and Vegetables (# 1478)
Growing Garden Tomatoes (# 1558)
Cucumber Diseases (# 1684)

Table 1 — Herbicides Recommended for Weed Control in Vegetable Crops

HERBICIDES	CROPS: Asparagus	Beans (Snap)	Beets	Broccoli, Brussel Sprouts	Cabbage, Cauliflower	Carrots	Celery	Corn (Sweet)	Cucumbers (Fresh)	Onions	Parsnips	Peppers	Potatoes	Rutabagas	Tomatoes
Afolan F, Lorox L	X					X	X[1]			X[1]					
AWK #1						X				X					
Amitrol T	X														
Bar-Fox, Na Ta TCA		X													
Basfapon/Dalapon/Dowpon/Dowpon M	X											X			
Basagran		X					X								
Buctril M							X								
CIPC + Randox								X							
2,4-D	X						X								
Dual							X								
Dyanap								X							
Eptam 8-E, Eptam 10-G		X										X	X		
Eradicane 8-E							X[b]								
Goal								X[4]							
Gramoxone (pre to crop)	X					X				X		X			
Gramoxone (stale to seedbed)		X	X	X[6]	X[6]	X		X	X	X		X	X		
Hoe-Grass 284						X				X[4]		X			
Karmex	X														
Kil-Mor							X								
Lexone DF, Lexone L												X			
Lexone DF or Lexone L + Eptam 8-E												X			
Pardner, Torch DS							X								
Prefar								X							
Prefar + Alanap 3[3]								X							
Primextra[3]							X[3]								
Princep Nine-T/Simadex/Simadex 80W	X														
Randox										X					
Rival		X		X	X	X					X		X	X	
Ro-Neet 7.2E			X												
Roundup — Pre to Crop												X			
Sencor 500, Sencor 75 DF												X			
Sencor 500 or Sencor 75 DF + Eptam 8-E												X			
Sinox PE		X					X[3]					X[2]			
Sutan +							X								
Totril										X					
Treflan EC		X		X	X	X					X		X	X	

WEEDS: Barnyard Grass; Blindweed (Field); Blue Bur; Buckwheat, Tartary; Buckwheat, Wild; Catchfly (Night Flowering); Chickweed, Common; Cocklebur; Cow Cockle; Field Horsetail; Flixweed; Foxtail (Green); Foxtail (Yellow); Goosefoot (Oak Leaved); Groundsel, Common; Hemp Nettle; Knotweed (Prostrate); Kochia; Lamb's Quarters; Lettuce (Prickly); Milkweeds; Mustard (Ball); Mustard (Dog); Mustard (Hare's Ear); Mustard, Indian; Mustard, Tumble; Mustard, Wild; Persian Darnel; Pigweed, Wormseed; Pigweed, Prostrate; Pigweed, Red Root; Pigweed, Russian; Pigweed, Tumble; Purslane; Quackgrass; Ragweed, Common; Ragweed, False; Ragweed, Giant; Shepherd's Purse; Smartweed, Lady's Thumb; Sow Thistle (Annual); Sow Thistle (Perennial); Spurge, Leafy; Spurge, Thyme-Leaved; Stinkweed; Thistle, Canada; Thistle, Russian; Toad Flax; Volunteer Corn; Volunteer Rapeseed, Mustard; Volunteer Wheat, Barley; Wild Oats; Wild Proso Millet; Wild Radish

Controls Annual Weed Seedlings and Top Growth of Perennial Weeds

Controls Annual Weed Seedlings and Top Growth of Perennial Weeds

Controls Annual Weed Seedlings and Top Growth of Perennial Weeds

LEGEND: HERBICIDES AND CROPS

X — Recommended on crop

[1] — Afolan only

[2] — Yellow Stuff PE only

[3] — These treatments may remain as a residue in the soil the following year. Flax, peas and fababeans are more tolerant crops.

[4] — Dry bulb onion only

[5] — Refer to Sweet Corn section for tolerant varieties

[6] — For use on Cabbage, Cauliflower and Brussel Sprouts only

[7] — Pre-emergent — Do not use Alanap[3] on Butternut Squash

LEGEND: WEEDS

● — Controlled by maximum rates recommended for crops. Where two brand names are recommended, the weed may not appear on both labels.

S — Suppression

O — Not labelled for control but adequate control can be expected

□ — Top growth control only

✱ — Controlled by rates less than the maximum recommended for crops.

[a] — Split application required for adequate control

[b] — For control, quackgrass must be cut up so that the remaining plant parts are 5 cm (2 inches) or less or 4 nodes or less in length prior to application. RATES REQUIRED TO CONTROL QUACKGRASS CAN BE USED IN POTATOES ONLY.

[c] — Apply to emerged weeds before or after planting, but before potatoes emerge.

[d] — Quackgrass control in asparagus only.

Table 2 - Insecticides Recommended for Insect Control in Vegetable Crops

INSECTICIDES	Bean (Snap)	Beets (Red)	Cabbage, Cauliflower, Brussel Sprouts, Broccoli	Carrots	Celery	Corn (Sweet)	Cucumbers, Pumpkins, Squash	Eggplant	Lettuce	Onion	Peppers	Potatoes	Radish	Rutabagas	Tomatoes	Aphids	Cabbage Looper	Cabbage Worm	Colorado Potato Beetle	Corn Earworm	Cucumber Beetle	Cutworm	Cutworm, Variegated	Diamond Back Moth Larvae	European Corn Borer	Flea Beetle	Leaf Hopper	Leaf Miners	Maggot Flies	Onion Maggots	Onion Maggot Flies, Thrips	Pepper Maggot	Potato Leaf Hopper	Radish Maggot	Root Maggots	Slugs	Tarnished Plant Bug	Wireworm
Ambush	●	●	●	●		●			●	●	●	●				X	X	X	X	X		X	X	X	X							X						
Bacillus Thuringiensis			●														X	X						X														
Belmark			●[3]									●				X	X	X	X					X		X[1]						X						
Birlane			●																														X					
Cygon		●	●								●	●				X														X					X			
Dasinit			●							●[4]				●														●					X					
Decis			●									●					X	X	X				X															
Diazinon		●	●							●			●	●			X	X					X				X	X	X	X			X					
Dyfonate												●																									X	
Furadan				●		●						●		●					X	X				X		●		X						X				
Guthion							●[B]					●							X		X				X													
Lannate			●			●											X	X		X			X	X														
Lorsban			●	●	●	●				●	●	●		●	●				X			X[2]			X[1]			X[2]								X	
Malathion	●	●	●	●	●		●	●	●		●	●	●	●	●	X									X	X	X			X					X		
Metaldehyde			●		●										●																				X			
Monitor			●									●				X	X	X	X				X															
Rotenone			●				●										X	X			X		X															
Sevin	●		●	●	●	●		●				●	●		●				X	X			X		X	X	X				X						
Supracide												●							X						X[1]						X							
Thimet									●			●							X																			
Thiodan	●		●		●	●	●	●			●	●		●	●	X	X	X	X	X	X		X	X		X	X	X			X					X	

NOTE: – Refer to specific crop section for insects controlled and to determine recommended product formulation and rates.

– Apply according to label directions.

– Refer to Page 9 for Pre-Harvest Wait Periods

– Products registered for use on crop

A – do not use on green bunching onions

B – For use only on cucumbers only.

X – Insects controlled at recommended rates.

[1] – Flea beetle control in Potatoes only.

[2] – Refer to General Pesticide Recommendations for recommended rates, page 11.

[3] – Belmark not registered for broccoli.

Table 3 — Fungicides Recommended for Disease Control in Vegetable Crops

FUNGICIDE	CROP: Asparagus	Beans (snap)	Beets Red	Cabbage, Cauliflower, Brussel Sprouts, Broccoli	Carrots	Celery	Corn (Sweet)	Cucumbers, Pumpkins, Squash	Eggplant	Lettuce	Onion	Peppers	Potatoes	Radish	Rutabagas	Tomatoes	DISEASES: Angular Leaf Spot (Cucumbers)	Asparagus Crown Rot/Seedling Blight	Anthracnose (Beans)	Bacterial Blight (Beans)	Blast, Purple Blotch	Downy Mildew (Onions)	Downy Mildew (Broccoli, Cauliflower)	Dry Rot (Potatoes)	Early and Late Blight and Leaf Spot (Carrots, Celery, Eggplant, Potato, Tomato)	Gray Mold (Onions)	Head Smut (Corn)	Powdery Mildew (Cucumbers)	Rust (Asparagus)	Scab (Cucumbers)	Seed Decay & Damp Off	Seed Piece Diseases, Potato	Silver Scurf (Potato)	Smut (Onion)	White Mold (Beans and Carrots)
Anilazine					7					1	7									X				X										
Benomyl	●	14[A]			●[b]			●									X	X							X		X		X					X
Captafol											1		1			1								X										
Captan (seed treatment)		●	●	●			●	●	●		●	●	●	●	●	●														X	X		X	
Carbathiin & Thiram (seed treatment)							●				●															X							X	
Chlorothalonil				7	1	7		1					1			1					X			X		X		X		X				
Fenaminosulf (seed treatment)		●	●				●	●[c]																						X				
Fixed Copper		1						1					1			1	X		X	X				X										
Iprodione		15									15																							X
Mancozeb				7	7	7					10		10			1							X		X									X
Maneb					5				5		10		1			3					X		X		X									
Metiram	●[a]				5								1			1					X				X									
Thiobendazole													●[d]											X							X	X		
Thiophanate methyl													●[e]																					
Thiram (seed treatment)		●	●	●	●	●	●	●	●	●	●	●		●	●	●														X			X	
Vitavax 280							●																			X								
Zineb	●[a]			7	7				5		7					5					X	X	X		X			X						

● = Recommended on Crop
A = Numbers indicate recommendations on crops and days between last spray and harvest
[a] = Do not apply to asparagus spears that are to be cut
[b] = post harvest dip or spray
[c] = Cucumbers only
[d] = Post harvest potato seed piece treatment
[e] = Seed piece treatment
NOTE: – Refer to specific crop section for diseases controlled and to determine recommended product formulation and rates.
– Apply according to label directories.

X = Indicates disease controlled

Table 4 — Compatibility Chart of Spray Chemicals

	Ambush	Basudin (diazinon)	Belmark	Benlate, Easout	Birlane	Bravo	Captan, Difolatan	Coppers (fixed)	Cygon, Dimethoate	Dasanit	Dipel, Thuricide	Dithane M-22, M-45	Decis	Dyfonate	Dyrene	Furadan	Guthion	Lannate	Malathion	Manzate-D, 200, Mantox	Methoxychlor	Monitor	Polyram, Zineb, Dithane Z-78	Rotenone	Sevin	Supracide	Thiodan
Ambush	/	O	O	*	O	*	*	*	O	O	*	*	O	O	O	O	O	O	O	*	O	O	*	O	O	O	O
Basudin (diazinon)	O	/	O	*	O	WP	*	D	*	O	*	D	O	O	O	O	*	*	*	D	*	*	D	*	*	X	*
Belmark	O	O	/	*	O	*	*	O	O	O	*	*	O	O	O	O	O	O	O	*	O	O	*	O	O	O	O
Benlate, Easout	*	*	*	/	O	*	*	X	*	*	*	*	O	*	*	*	*	*	*	*	*	*	*	X	*	*	*
Birlane	O	O	O	O	/	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	
Bravo	*	WP	*	*	O	/	*	*	*	*	*	*	O	*	*	*	WP	C	WP	*	*	*	*	*	*	X	*
Captan, Difolatan	*	*	*	*	O	*	/	D	*	O	*	*	O	O	O	*	WP	*	WP	*	WP	WP	*	*	*	*	*
Coppers (fixed)	*	D	O	X	O	*	D	/	*	O	*	D	O	O	*	O	*	*	*	D	*	*	D	*	X	O	WP
Cygon, Dimethoate	O	*	O	*	O	*	*	*	/	O	*	*	O	*	*	O	*	*	*	*	*	*	*	*	*	*	*
Dasanit	O	O	O	*	O	*	O	O	O	/	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Dipel, Thuricide	*	*	*	*	O	*	*	*	*	O	/	*	O	*	O	*	*	*	*	*	*	O	*	O	*	O	*
Dithane M-22, M-45	*	D	*	*	O	*	*	D	*	O	*	/	O	O	O	*	WP	*	D	*	WP	*	*	O	*	O	*
Decis	O	O	O	O	O	O	O	O	O	O	O	O	/	O	O	O	O	O	O	O	O	O	O	O	O	O	*
Dyfonate	O	O	O	*	O	*	O	O	*	O	*	O	O	/	O	O	*	O	O	O	O	O	O	O	O	O	*
Dyrene	O	O	O	*	O	*	O	*	*	O	O	O		O	/	*	*	C	*	O	*	*	*	*	*	O	*
Furadan	O	O	O	*	O	*	*	O	O	O	*	*	O	O	*	/	O	O	O	*	O	O	*	O	O	*	*
Guthion	O	*	O	*	O	WP	WP	*	*	O	*	WP	O	*	*	O	/	*	*	WP	*	O	WP	*	*	*	*
Lannate	O	*	O	*	O	C	*	*	*	O	*	*	O	O	C	O	*	/	*	*	*	*	*	C	*	O	*
Malathion	O	*	O	*	O	WP	WP	*	*	O	*	D	O	O	*	O	*	*	/	D	*	*	D	*	*	O	*
Manzate-D, 200, Mantox	*	D	*	*	O	*	*	D	*	O	*	*	O	O	O	*	WP	*	D	/	WP	*	*	O	*	O	*
Methoxychlor	O	*	O	*	O	*	WP	*	*	O	*	WP	O	O	*	O	*	*	*	WP	/	O	WP	*	*	O	*
Monitor	O	*	O	*	O	*	WP	*	*	O	O	*	O	O	*	O	O	*	*	*	O	/	O	*	*	O	*
Polyram, Zineb, Dithane Z-78	*	D	*	*	O	*	*	D	*	O	*	*	O	O	*	*	WP	*	D	*	WP	O	/	*	*	*	*
Rotenone	O	*	O	X	O	*	*	*	*	O	O	O	O	O	*	O	*	C	*	O	*	*	*	/	*	O	*
Sevin	O	*	O	*	O	*	*	X	*	O	*	*	O	O	*	O	*	*	*	*	*	*	*	*	/	*	*
Supracide	O	X	O	*	O	X	*	O	*	O	O	O	O	O	O	*	*	O	O	O	O	O	*	O	*	/	*
Thiodan	O	*	O	*	O	*	*	WP	*	O	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	/

* = Generally compatible.
X = Incompatible, do not use
O = Not usually mixed or compatibility unknown.
WP = Use wettable powder forms.
D = Decomposes on standing, use immediately.
C = Generally satisfactory, but occasionally damage occurs.

This chart applies only to the use of two material combinations. When three or more materials are mixed or when a wettable powder and a liquid formulation are mixed, incompatibility may develop. *In call cases follow directions on the label.*

SPREADERS and STICKERS (SURFACTANTS) — Usually surfactants are incorporated into pesticide formulations by the manufacturer. Unless otherwise specified on the pesticide label, *do not* add surfactants.

Table 5 — Nitrogen Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Nitrogen (N) Recommendations kg/ha (lb/acre)

Crop	Soil Nitrate-Nitrogen Content to 60 cm (24 in) kg/ha (lb/acre)							
	0-25 (0-22)	26-50 (23-45)	51-70 (46-62)	71-90 (63-80)	91-100 (81-89)	101-110 (90-98)	111-130 (98-116)	131-140 (116-125)
● Set and Pickling Onions ● Radishes ● Beets ● Rutabagas	50-100 (45-89)	0-49 (0-44)	0	0	0	0	0	0
● Asparagus at establishment ● Beans, ● Carrots, ● Parsnips ● Vine crops including Cucumber, Squash, Pumpkin	90-140 (80-123)	40-89 (36-79)	0-39 (0-35)	0	0	0	0	0
● Corn ● Egg Plant, ● Garlic ● Cooking Onions ● Peppers ● Tomatoes	130-180 (116-160)	80-129 (71-115)	79-40 (36-70)	0-39 (0-35)	0	0	0	0
● Established Asparagus ● Endive ● Lettuce ● Spinach	150-200 (134-178)	100-149 (89-133)	60-99 (54-88)	20-59 (18-53)	0-19 (0-17)	0	0	0
● Broccoli ● Brussell Sprouts ● Summer Cabbage ● Cauliflower	170-220 (151-196)	120-169 (107-150)	80-119 (71-106)	40-79 (36-70)	20-39 (18-35)	0-19 (0-17)	0	0
● Storage (Winter) Cabbage	210-260 (187-232)	160-209 (143-186)	120-159 (107-142)	80-119 (71-106)	60-79 (54-70)	40-59 (36-53)	0-39 (0-35)	0
● Celery	230-280 (205-250)	180-229 (160-204)	140-179 (125-159)	100-139 (89-124)	80-99 (71-88)	60-79 (54-70)	20-59 (18-53)	0-19 (0-17)
● Potatoes (1)	77-100 (67-89)	53-76 (47-68)	35-52 (31-46)	35 (31)	35 (31)	35 (31)	35 (31)	35 (31)

NOTE: (1) For the above crops except potatoes, if the nitrate nitrogen content of the 0-15 cm (0-6 in) sample is less than 20 kg/ha (18 lb/acre) a minimum recommendation of 40 kg/ha (36 lb/acre) fertilizer N will be made regardless of the total nitrate content.

(2) For all of the above crops, if the nitrate content in the 15-60 cm (6-24 in) exceeds 125 kg/ha (112 lb/acre) the following comment is printed on the soil test report "Nitrate-nitrogen in the lower soil depth is extremely high; probably reflecting an accumulation from past applications of high rates of nitrogen fertilizer. Soil testing should continue on an annual basis to monitor this situation and to determine sound fertilizer nitrogen application rates.

Table 6 — Phosphorus Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Phosphate (P_2O_5) Recommendation kg/ha (lb/acre)

Crop	Available Phosphorus (P) to 15 cm (6 in) soil depth kg/ha (lb/acre)					
	Very Low 0-11 (0-10)	Low 12-19 (11-17)	Medium 20-28 (18-25)	High 29-40 (26-36)	Very High 41-100 (37-89)	Very High+ 100+ (89+)
● Asparagus ● Beans ● Beets ● Carrots ● Corn ● Endive ● Garlic ● Lettuce ● Onions ● Parsnips ● Peas ● Radishes ● Rutabagas ● Spinach ● Vine Crops including Cucumbers, Pumpkins and Squash	178-200 (159-178)	162-177 (144-158)	144-161 (128-143)	120-143 (107-127)	0-119 (0-106)	0 0
● Broccoli ● Brussell Sprouts ● Cabbage ● Cauliflower ● Celery ● Eggplant ● Pepper ● Tomatoes	222-250 (198-223)	202-221 (180-197)	180-201 (160-179)	150-179 (134-160)	0-149 (0-133)	0 0
● Potatoes	60 (54)	53-59 (47-53)	45-52 (40-46)	36-44 (32-39)	35 (31)	35 (31)

NOTE: (1) For all crops except potatoes above rates are based on phosphate fertilizer being applied as broadcast and incorporated. If the phosphate fertilizer is to be sidebanded, the rates can be reduced to ⅓ above rates.

(2) For potatoes the above rates are based on phosphate fertilizer being sideband applied at time of planting.

Table 7 — Potassium Recommendations For Vegetable Crops

(Recommendation Based On Procedures Used By The Provincial Soil Testing Laboratory)

Potassium (K_2O) Recommendation kg/ha (lb/acre)

Crop	Available Potassium (K) to 15 cm (6 in) soil depth					
	Very low 0-95 (0-85)	**Low 96-191 (86-170)**	**Medium 192-287 (171-256)**	**High 288-383 (257-342)**	**Very High 384-450 (343-401)**	**Very High+ 451+ (402+)**
● Bean ● Peas	70 (62)	35 31	0	0	0	0
● Beets ● Carrots ● Corn ● Endive ● Egg Plant ● Garlic ● Lettuce ● Onions ● Parsnips ● Pepper ● Radishes ● Spinach ● Tomatoes ● Vine Crops including Cucumber, Pumpkin, Squash	178-225 (156-201)	134-177 (120-157)	82-133 (73-119)	34-81 (30-72)	0-33 (0-29)	0
● Broccoli ● Brussell Sprouts ● Cabbage ● Cauliflower ● Celery ● Rutabagas	237-300 (211-268)	173-235 (154-210)	109-172 (97-153)	49-108 (44-96)	0-48 (0-43)	0
● Asparagus	335-425 (299-379)	245-334 (218-298)	154-244 (137-217)	63-153 (56-136)	0-62 (0-55)	0
● Potatoes	95-110 (85-98)	78-94 (70-84)	62-77 (55-69)	47-61 (42-54)	0-46 (0-41)	0

NOTE: (1) For all crops except potatoes above rates are based on potassium fertilizer being applied as broadcast (and incorporated if feasible).

(2) For potatoes, the above rates are based on potassium fertilizer being sideband applied at time of planting. If sideband application is not feasible, the above potassium fertilizer rate should be doubled, broadcast applied and incorporated.

Table 8 — Sulphur Recommendations For Vegetable Crops

(Recommendations Based On Procedures Used By The Provincial Soil Testing Laboratory)

Soil Sulphate – Sulphur (Content to 60 cm (24 in) kg/ha (lb/acre)	Category	Sulphur Recommendation (All Vegetable Crops) kg/ha (lb/acre)
0-11 (0-10)	Very Low	30 (27)
12-22 (11-20)	Low	30 (27)
23-33 (21-29)	Medium	30 (27)
34-44 (30-39)	High	0
45-66 (40-59)	Very High	0
67+ (60+)	Very High+	0

NOTE: Sulphur fertilizer recommendations are based on sulphur being applied in the sulphate ($SO_4=$) form since it is the only form readily available to plants.